Low Cost Radio frequency Controlled Robot for Environmental Cleaning

M.Muthiah
Electrical and Electronic Engineering,
Sri Venkateswara College of Engineering,
Chennai,Tamil Nadu,India.
msmuthiah@gmail.com

K.Nirmal
Electrical and Electronics Engineering,
Sri Venkateswara College of Engineering,
Chennai,Tamil Nadu,India.
nirmalcool55955@gmail.com

Rk.Sathiendran
Arobot,
Tamil Nadu,India.
sathiendran.rk@gmail.com

***Abstract*-The paper presents the technical construction of a robot which is used in cleaning. The term "cleaning" sounds simple, yet we humans face a lot of problems with the disease ridden workplace, a few examples are factories, power plants, Bio-hazard chambers etc., where it is harmful for humans to work. RF signal is used to control this robot. It uses an Induino (micro-controller) for its operation. The mechanical part is the base (rectangular wooden piece) with servo motor and the wheels (plastic wheels) in our case. The material used in mechanical part can be changed according to our prerequisite. The electronic part consisting of the RF signal receiver, Induino and the surveillance Camera are mounted on the base of the robot. The camera acts as the "eye" of the operator transferring live video data wireless either using W-Lan or using cloud computing (in case of monitoring over large distance). The cleaning mechanism includes a normal brush (material of the brush is selected as required) with a servo motor attached to it. This robot not only helps in cleaning rather can be used to monitor things.**

Keywords- Cleaning robot, surveillance robot, RF controlled robot

I. INTRODUCTION

The term "CLEANING" sounds simple yet we humans face a lot of problems with the disease-ridden workplace.

The Nováky Power Station (NPS) has been using since 1953 as fuel coal with a high content of As and with a low content of other metals. This involves a constant risk for the workers as well as pollution of the surroundings. Buchancováj ,Klimentová G, Knizková M, Mesko D, Gáliková E, Kubík J, Fabianová E and Jakubis M, analysts at Clinic of Occupational Medicine and Toxicology, Martin Faculty Hospital, Slovakia Republic described 16 cases of chronic as intoxication in NPS workers after 22.3 +/- 8.4 years of exposure (especially stokers, maintenance workers, boiler Cleaners). Every person involved in the simple work of "CLEANING". Among clinical symptoms prevailed sensory and motor polyneuropathy (13 cases), pseudo neurasthenic syndrome (10 cases), toxic encephalopathy (6 cases) and nasal septum perforation (2 cases). After 1989 the intoxications with as did not occur any more due to technical measures and health protection of the workers. The authors present a review of actual results of clinical, hematological and biochemical investigations and tests for metals (AAS methods) in biological materials of workers at risk in NPS (n = 70), exposed on average for 11.9 +/- 0.5 years, of average age 35.91 +/- 1.7 years (mean +/- SE) and compared the results to a matched control group of blood donors not exposed to metals (n = 29). In NPS workers significantly lower Hb values, higher serum creatinine, higher serum beta 2-microglobulin, higher As content in hair as well as higher serum Mn and Pb concentrations compared with the C-group were found. The exposed group had significantly lower serum Se concentrations (0.64 +/- 0.025 mumol/l (mean +/- SE) compared to Se levels of persons from an adjacent district. The authors stress the necessity of individual evaluation of the metal concentrations in relation to clinical findings. With prolonged exposure the situation can become more urgent not only because of chronic poisoning but also because of the cancer genic effects of these elements on the human organism [1]. This robot can thus help us in this simple process of cleaning and saving precious human lives. Not only in power plant , humans are forced to work in an disease-ridden environment just for cleaning and maintenance work, such as bio-hazard chambers, Radiation laboratories etc.

978-1-4799-7075-9/15/$31.00 ©2015 IEEE

II. TECHNOLOGY USED

RF(Radio Frequency) concept is used in this robot as it can be used in various industries and radiation labs. The same robot can be controlled by Dual Tone Multiple Frequency (DTMF) signals but the disadvantage is that the mobile network coverage cannot be guaranteed. Moreover if it's done by DTMF and the network coverage is cutoff in between the working of the robot then the robot travels in the last received signal until it regains the network coverage and might collide on or fall from a certain height. But in case of Radio Frequency (RF), if the signal is cutoff in between the working of the robot then the robot stops at the same place and does not travel in the previous received signal and thus can avoid any damage done to the robot or the surroundings.

III. DESIGN:

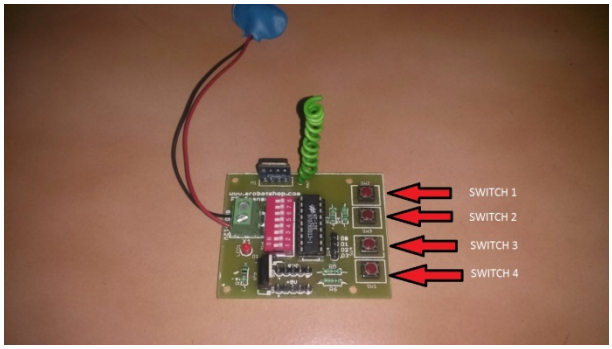

FIG 1 :RF Control Board

Since there are 4 switches available in the above rf board there are 16 different operations possible out of which we use 8 operations.

TABLE I: Controller options of RF Control board

S.NO	*SWITCH*	*ACTION OF THE ROBOT*
1	1	Forward
2	2	Forward left
3	3	Forward Right
4	4	Backward
5	1 & 3	Backward left
6	2 & 4	Backward right
7	2 & 3	Cleaning shaft down
8	1 & 4	Cleaning shaft up

IV. PLATFORM USED

The Induino R3 is a low cost Arduino Rev3 Clone with a "ATmega328" microcontroller loaded with Arduino UNO bootloader. Rev3 compatibility ensures that the board works with the newer versions of the arduino shields.

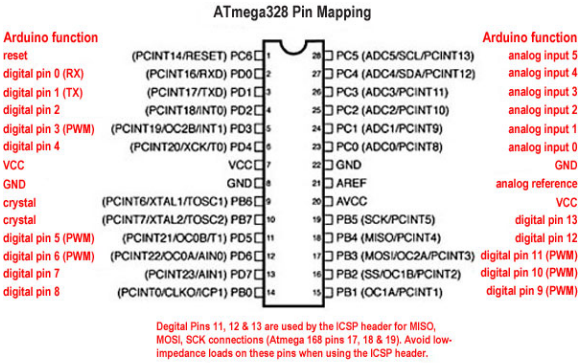

FIG 2: ATMEGA328 Pin Mapping

V. WORKING

A. L293D-Motor Driver IC

This robot uses L293D chip for its movement.

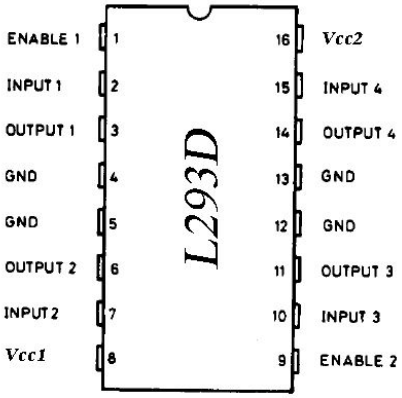

FIG 3: Pin Diagram of L293D

Initially when switch 1 is pressed in the rf transmitter board, the high signal is received by the controller from the receiver board and the controller makes the digital pins 7 and 8 HIGH which is connected to the pin 2 and 7 in L293D chip that makes the robot to move forward. Similarly all the other movements of the robot are controlled in the similar fashion.

B. Ultrasonic Sensor

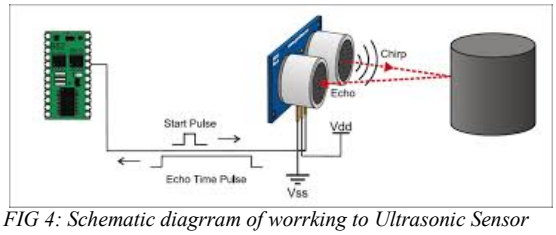

FIG 4: Schematic diagrram of worrking to Ultrasonic Sensor

Ultrasonic sensors (also known as **transceivers** when they robot send and receive, but more generally called **transducers**) work on a principle similar to radar or sonar, which evaluate

attributes of a target by interpreting the echoes from radio or sound waves respectively. Active ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor, measuring the time interval between sending the signal and receiving the echo to determine the distance to an object. Passive ultrasonic sensors are basically microphones that detect ultrasonic noise that is present under certain conditions.[2]

The robot uses an ultrasonic sensors robot at the front and back to prevent any collision or damage to the robot or its surroundings.

C. Servo Motor

FIG 5: Servo Motor

A **servomotor** is a rotary actuator that allows for precise control of angular position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.[3]

The robot has a 5kg servo motor to move the cleaning shaft up and down. When switches 2 & 3 are pressed the controller moves the shaft to 20 degree and 75 degree for switches 1 & 4.

D. Surveillance Camera

FIG 6: Image of DCS-933L Camera

The DCS-933L is a standalone surveillance camera. It can send e-mail notifications with snapshots or video clips whenever motion or sound is detected using just the DCS-933L and an internet connection. Night time monitoring is possible with the built-in infrared LEDs which allow for night time viewing of up to 16 feet (5 meters), enabling round-the-clock monitoring of the place where the robot is present. The video is transmitted wirelessly over the wifi to the internet, which can be viewed in the dlink id.[4]

TABLE II: Specification of DCS-933L Camera:

SPECIFICATIONS	
Camera Hardware Profile	1/5" VGA progressive CMOS sensor, 5 meter IR illumination distance minimum illumination, 0 lux with IR LED on, Built-in Infrared-Cut Removable (ICR) Filter module, 4X digital zoom Fixed length 3.15 mm, Aperture F2.8, Built-in Microphone
Image Features	Configurable image size, quality, frame rate, and bit rate Time stamp and text overlays, Configurable motion detection windows, Configurable brightness, saturation, contrast
Video Compression	H.264/MJPEG format compression simultaneously, JPEG for still image
Audio Compression	PCM
Video Resolution	640 x 480, 320 x 240, 160 x 112 at frame rates up to 30 fps
Connectivity	10/100 BASE-TX Ethernet port , 802.11n wireless
Security	Password authentication, HTTP digest encryption

E. *PIR(PYROELECTRIC SENSORS)*

FIG 7: Image of PIR

All objects with a temperature above absolute zero emit heat energy in the form of radiation. Usually this radiation is invisible to the human eye because it radiates at infrared wavelengths, but it can be detected by electronic devices designed for such a purpose.[5]The term *passive* in this instance refers to the fact that PIR devices do not generate or radiate any energy for detection purposes. They work entirely by detecting the energy given off by other objects. PIR sensors don't detect or measure "heat"; instead they detect the infrared radiation emitted or reflected from an object

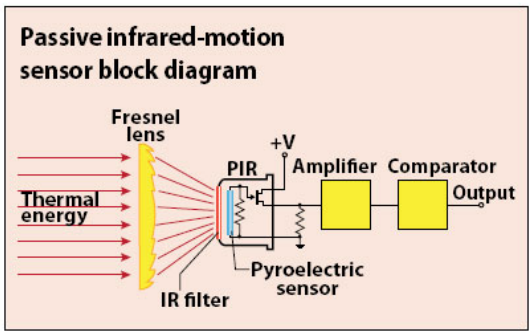

FIG 8: Block Diagram Of Infrared-Motion Sensor

Human body emits infrared radiations of wave length of 9.4 micro meters which when detected by PIR makes the buzzer go high in the robot. This makes the people in industries or radiation labs aware of the robot nearby. This might be very useful for the people in nuclear radiation centres where they wear heavy gadgets and shields to protect themselves from radiation that they might not see the small robot cleaning and might fall over it. In that case the sound made by the buzzer is very useful.

F. SPECIFICATIONS OF THE ROBOT

- Robot length:30cm
- Robot width:21cm
- Robot height:3.5cm
- Wheels diameter:7cm
- Wheels rpm:300
- Battery: There are 3 batteries used

a. HW(hi –watt) battery for RF receiver
Output voltage: 9v
Width x height x depth=2.65 x 4.8 x 1.75 cm

b. Lithium polymer battery
Width x height x depth=2.5 x 8.5 x 2.5 cm
Output voltage=11.1v
Output max current=1800mAh

c. Nokia portable charger DC-16 for the wireless camera.
Width x height x depth=2.3 x 12 x 2.3 cm
Output voltage=5v
Output max current=2200mAh

FIG 9: Side View of the Bot

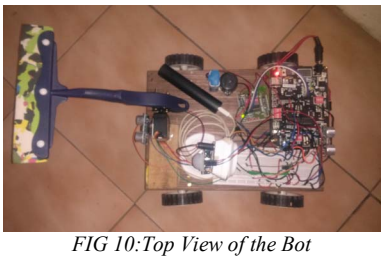

FIG 10:Top View of the Bot

FIG 11: Side View Of the Bot

FIG 12:Front View of the Bot

VI. APPLICATIONS AND MODIFICATIONS

- It can be used in the nuclear power plant to clean the D2O (heavy water) on the surface of nuclear power plant ,which act as a moderator to slow down the neutrons from which nuclear radiations can occur.
- It can also be used in various radiation labs, bio-hazard chambers.
- In labs where carcinogenic radiations occur which cause cancer.
- It can also be used in thermal power plant where the ash obtained after burning coal is cleaned before mixing with the sea water and can be used in cement factories.
- It can be used in various areas which are very small for the humans to clean for which the robot is resized according to the specifications like ventilation shafts, to remove the blockages in pipes or tunnels etc.
- With proper lever mechanism this can be used to clean windows and this at greater heights.
- The base must be fabricated as an holonomic bot to move with greater degree of freedom.[6]
- With sand papers attached to the wheels of the robot and with vacuum suction technology it can **also climb walls and clean the ceilings of the wall and other equipments.** [7]

VII. CONCLUSION

The main idea of this paper was to construct a simple robot that assists humans in the purpose of cleaning in places where it is unsafe for the humans to work with. The advantage is that with the additional facilities such as the wireless camera, it makes the robot easy and user friendly for the human to work with. Using nano-tech this robot can be used in places such as air-craft vents were even human hands could not get through and thereby avoiding blockages. Thus with this simple robot that helps us in the purpose of cleaning will save a lot of human lives.

VIII. REFERENCES

[1] Health status of workers of a thermal power station exposed for prolonged periods to arsenic and other elements from fuel.URL: http://www.ncbi.nlm.nih.gov/pubmed/9524739

[2] http://en.wikipedia.org/wiki/Ultrasonic_sensor

[3] http://en.wikipedia.org/wiki/Servomotor

[4] http://www.dlink.com/me/sr/support/product/dcs-933l-day-night-network-camera

[5] http://en.wikipedia.org/wiki/Passive_infrared_sensor

[6] Sai k.v.s and Sivaramakrishnan R "Design and Fabrication of Holonomic Motion Robot Using DTMF Control Tones" in Control, Automation, Communication and Energy Conservation, 2009.

[7] Ravi Chanchlani, Sarvesh Kulchanya Rahul Swami, Rakesh Agarwal, Sarvesh Sharma, Mayank Agrawal and Reema Agarwal "Intelligent Climber: A Wireless Wall-Climbing Robot Utilizing Vacuum Suction and Sand Paper" in 2013 Texas Instruments India Educators' Conference