International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 04 | Apr-2018 www.irjet.net p-ISSN: 2395-0072

AUTONOMOUS OPERATED ROBOT FOR WATER TANK CLEANING

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ABSTRACT: *There has been a tremendous growth of use of water tanks especially in a populated country like India. The source of water very from place to place. It may be a groundwater, rainwater or water combined from two or more sources. Every day we use the tank water for brushing and bathing, for cleaning and moping, for washing clothes and in other household chores. The water stored in it may have fine particles suspended particles or impurities in dissolved form. With the passage of time, sediments, scale and algae get deposited on the walls, ceiling and floor of the water tank. Other possibilities of impure water are dust or suspended solids inside water, germs, bacteria, or parasite growth. These deposition contaminates the water and makes is unfit for use. Hence water tank cleaning is very important but, it is a tedious job. When manual cleaning process is considered, it is a risky task. Considering height of water tanks the shortage of oxygen can be a major issue and may even result into accidents. The other problems include improper light for vision, lack of provisions to get in and out of the tank, slippery floor and risk of damaging the tank in case it is made of plastic or lightweight material.. Hence the need for use of robotic systems has become more apparent. . The proposed robot will clean the water tank without much effort. However, a human part is needed to take the robot to the location of the tank and to place the robot inside the tank. Once placed in the tank, the robot cleans the tank autonomously and the user can take out the robot after the completion of the process. The robot takes care of the operations like cleaning, brushing, sucking etc.*

KEYWORDS: **Autonomous, water tank, high-pressure water, robot.**

I. INTRODUCTION

Our proposed robot will have an Arduino controller, high-pressure water pump, suction pump, ultrasonic sensors and battery inside the robotic body and robotic arm on the top of its body. To clean the desired water tank, a person has to manually place the robot inside the tank. Then the operation is completely autonomous and after completion of the cleaning operation, the robot can be taken out. Before placing the robot inside the tank, the water present inside the tank will be completely drained using an outlet. The robot uses ultrasonic sensors for calculating the distance from its location to the sides of the wall. Based on the output from an ultrasonic sensor, the robot will move accordingly to reach the centre of the tank. The high-pressure water pump will be present inside the robot. The water will be supplied to the pump from outside of the tank. This water will be used for cleaning the tank. There will be a robotic arm present on the top of the tank. The pump output is terminated as a small nozzle at the robotic arm. The robot first moves in the forward direction and the arm will move in up and down as well right and left direction to pump out high- pressure water to the walls of the tank. In case of heavy scaling inside the tank, chemical agents can be mixed with the cleaning water. When the robot completes the entire cleaning process in the forward direction, it again reaches its default tank centre position. Now, it moves in the reverse direction and performs the same operation. The entire body of the robot will be water sealed and all components will be present in the waterproof body. Only, the robotic arm will be exposed outside. Now, as the walls of the water tank are cleaned. The robot moves around the entire tank and cleans the floor of the tank using rotating scrubber present at the bottom of the tank. There will be dirty water and sludge remaining at the bottom of the tank. It will be sucked out using the suction pump present inside the robot.

II. LITERATURE SURVEY

There is an existing Remotely Operated Vehicle (ROV) for water tank cleaning[2]. This ROV was designed in Solidworks platform and uses Raspberry Pi controller. It is an underwater robot that can work effectively up to the depth of 1 meter. The disadvantage of this robot is there is a need for a human operator to control the robot. There is also a research work on a rugged robot for oil tank sludge cleaning[1]. This robot may be suitable for other industrial tank cleaning but not for domestic tank cleaning because of its size, cost and mechanism. Moreover, its rugged explosive proof body may also damage the plastic water tanks. There is also a machine for water tank cleaning [3]. This machine is fitted on the opening of the water tank and with the help of rack and pinion, a brush will move up and down inside a water tank and clean it. The working and construction of this machine is quite simple. But, it is heavy and not suitable for tanks of different dimensions.

III. BLOCK DIAGRAM

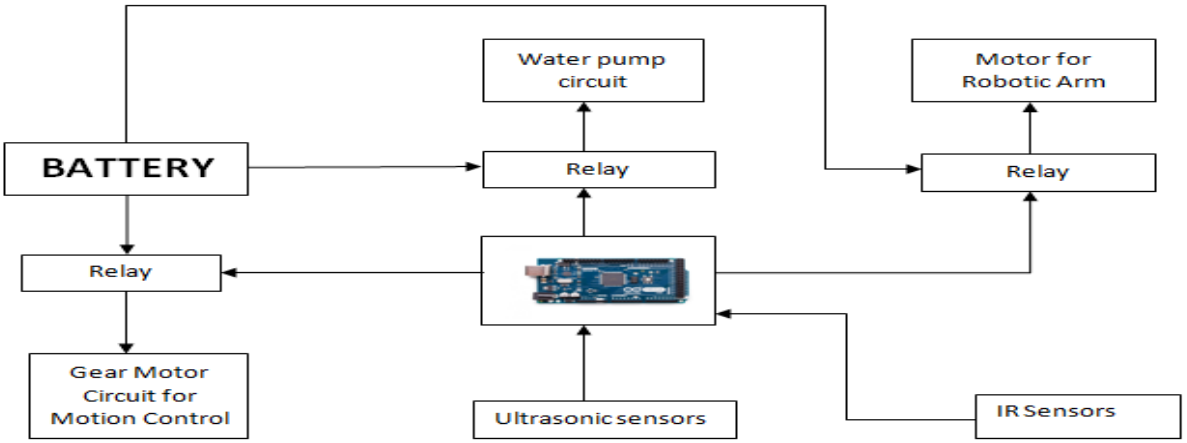


Fig. 1- Complete Block diagram of the Robot

IV. COMPONENTS

The three main sub circuits present in the main design is motion control circuit, water pumping circuit and robotic arm control or nozzle control circuit. The Arduino input supply can be between 7V- 12V. But due to excessive heat produced when operated for a long time, the 12V is reduced to 9V with the help of buck converter and fed to the Arduino board.

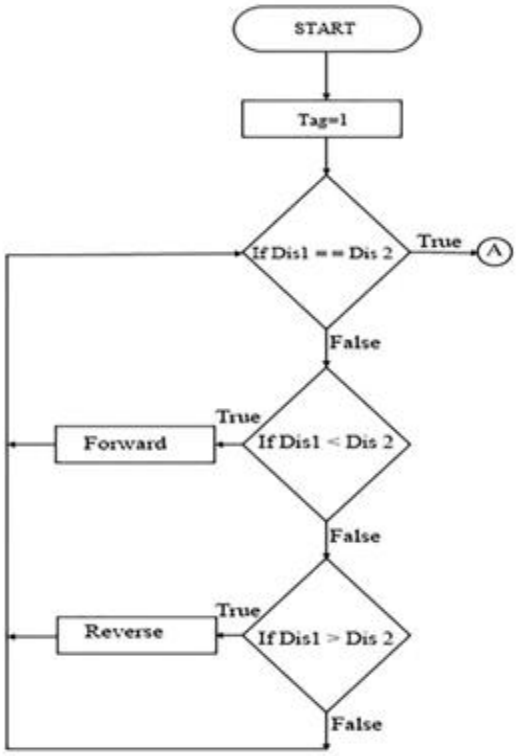
Arduino Mega is used as the controller in this robot. It has 54 digital I/O pins. Out of which 16 can be used as PWM output and it also has 16 analog input pins. The analog input pins accept signals from various sensors and digital IO pins are used to send control output from Arduino. The 12 V, 7.2 Ah Lead acid battery is used to power all the components present in the robot. Four 12 V high torque gear motors are used for the motion of the robot. The high torque is required since the estimated total weight of the robot is between 12 kg to 16 kg. The Arduino output is just 5V, so the relay is needed to supply 12 V to the motors. The chassis is made of lightweight metal, aluminium. Aluminium is also preferred because of its less corrosive nature.

The robotic arm is made up of acrylic glass. Water Proof Ultrasonic Sensor modules will be mounted on the front and back side of the chassis. The 12V high-pressure diaphragm type water pump will be used to pump the cleaning water from outside.

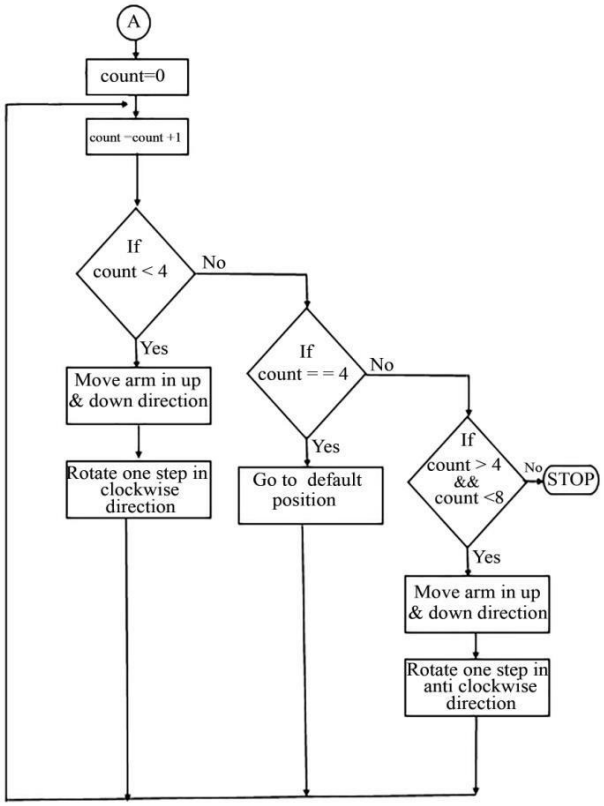
V. FLOWCHART

The coding is done using Arduino IDE and dumbed into Arduino Mega. After executing the motion control logic (as shown in flowchart 1), the control logic for robotic arm (flow chart 2) executes.

FLOWCHART 1



Flowchart 2



VI. CONCLUSION

After a detailed study, it is concluded that there is hardly a complete autonomous robot suitable for cleaning domestic water tanks. This work could be the solution to that problem. Our future work would be to develop a robot to clean both domestic as well as industrial tanks.

ACKNOWLEDGEMENT

The authors thankfully acknowledge the contribution of the financial support provided by The Institution of Engineers (India) for carrying out Research and Development work in this subject.

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