AUTONOMOUS DRAINAGE CLEANING ROBOT USING EMBEDDED SYSTEM

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Abstract : A fully Autonomous Drainage Cleaning Robot is used to clean the mud or dirt inside the pipe. The autonomous pipe cleaning robot has four tracks to make smooth mobility inside the pipe. The track was attached with a foldable linkage. The foldable linkages give the potential to the robot to move horizontally or vertically inside the pipe. The drainage system and track design was combined to maximize the efficiency of the robot. Furthermore, the track wheel will give more friction between the robot and the pipe. Thus it can prevent the robot from tottering or spinning inside the pipe. The wire brushes are an fruitful way to remove the mud inside the pipe. This gives the idea of combining the robot technology with the wire brush's cleaning technology. The brushes are attached behind the robot. The brushes will rotate to clean the mud. The cleaning process will begin if the sensors detect the mud. If the sensors do not detect any objective in its way, the cleaning process will not happen.

IndexTerms **- Autonomous robot, Drainage issues, Arduino-Uno, User friendly.**

I. INTRODUCTION

When we talk about basic needs of a human being it includes food, water, air and shelter. In this water is a very essential component for once livelihood and we all know that the 71% of the earth surface is made of water but in those 71% the majority of water that is 97% consumed by ocean and remaining 3% is only fresh water in the 3% of fresh water only 1.5% is only drinkable water.

In earth there is large amount of water which can't be utilize for human use, as ocean water consists of large amount of salt. Clean and fresh water is very essential for regular usage, The large amount of impurities present in water can became very dangerous and can proved to be life threatening to humans and other living beings. In most of the countries the waste and processed water has been treated through majority of the drainage system, the main function of the drainage system is to collect the waste particles like plastic bottles, waste papers, polythene bags and other humans contaminated wastes.

The wastages in the drainage can cause blockage in the water path and reduce the flow of water, To avoid such situation the blockage can be prevented by regularly cleaning and maintaining the drainage system for smooth working of drainage system, the drainage system can be maintained by manually or automatically using machines or systems to throw out such waste particles out and will help to keep the water clean and fit for usage.

We all know that in India, most of the cities lack proper drainage systems, which results in flooding in urban areas, property loss, and even causes hazardous effects on human health. In a recent study the number of people who died while cleaning drainages and septic tanks in the country has been increased by almost 62% from 68 in 2018 to 110 in 2019 (*source: Social Justice Ministry in the Lok Sabha on February 11, 2020). The rising of human deaths can be seen by the chart below,

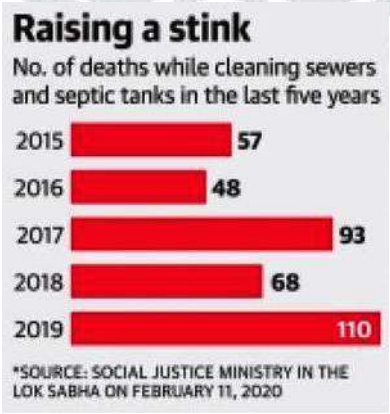

Figure 1: Graph showing the number of deaths over the year

Our project is designed to keep the drainage system clean and helps the smooth working of the system. Our project automatically cleans the water in the drainage system each time any impurity appears, and this forms an efficient and easy way of cleaning the drainage system and preventing its blockage. Nowadays even though automation plays a vital role in all industrial applications in the proper disposal of sewage from industries and commercials are still a challenging task. Drainage pipes are using for disposal and unfortunately, sometimes there may be loss of human life while cleaning the blockages in the drainage pipes. To overcome this problem and to safeguard human life we implement a design "Autonomous Drainage Cleaning Robot using Embedded

Systems". We designed our project to use this inefficient way to control the disposal of wastages and with regular filtration of wastages, clearance of gaseous substances are treated separately and continually monitor the disposal. It also reduces manual work and improves the quality of water that is cleaned.

II. OBJECTIVES

Based on the study, the product objectives are the list of features that are taken into consideration. The following are the list of product objectives and how they will be obtained or measured to ensure that the goal of the project was met.

- To construct a machine that is easy to use and movements of parts occur smoothly.
- To build a device that is durable as it should be free from rust.
- To construct the light-weighted and compact machine.
- To build a machine that is safe in all aspects as it does not harm the interior of the drainage system.
- Connected to the machine there will be a storage tank to store the waste collected from gutters.
- To make the proper usage of the waste materials.
- To make our project user friendly and eco friendly.
- To design the machine inconvenient manner to separate the solid waste.
- The machine should be economically designed.
- Handling the machine should be easy.
- Project future quantities of waste generation and management in India.
- Investigate the potential for recycling.
- Estimate cost and revenue of managing generated.

III. PROPOSED METHOD

As strange as it might seem, there is no standard terminology for a robot. However, there are few essential characteristics that a robot must have and this might help you to decide what is and what not a robot is. It will also assist you to decide what features you will need to build into a machine before it can count as a robot. Robo drainage Cleaner is a machine that cleans automatically. Once it starts then Robo cleaner cleaned the whole drainage. Robo Cleaner uses two motors to control rear wheels and the single front wheel is free. It has infrared sensors, on the left, right, and front side to detect walls or any obstructs when the sensors detected any obstructs, the output of the comparator, LM324 is high logic and the other output is low. Microcontroller Atmega 8A and H-Bridge driver L293 were used to control the direction and speed of the motor. Sensing obstructs and maneuvering the robot to stay on course, while constantly correcting wrong moves using a feedback mechanism forms a simple yet effective closed-loop system. As a programmer, you get an opportunity to „teach" the robot how to move when obstructs has come.

CLEANING PRINCIPLES AND ROBOT STRUCTURE

Most cleaning machines use a vacuum as the principal cleaning device, but in our case, the cleaning device has been adapted from a commercially available electric broom, because this paper aims to focus on the mobile robot problem. The cleaning principle of the original machine is based on a battery-powered roller brush that is ideal for a robotic application. Depending on the surface type, the roller brush can be very effective because it cleans by friction, and the rotation itself also generates a suction airflow that avoids dust generation. Moreover, its design is very simple and cheap, having only three parts: a roller brush, a dustpan, and a broomstick. Therefore, the proposed design includes the original cleaning components. The initial dustpan has been extended with a box for the motors in the back. An additional upper part contains the electronic components and sensors and a handle for easy transportation.

WHEELS AND MOTORS PLACEMENT

The two dc geared motors with the wheel attached to the gear axis are used for driving the robot. The best placement for the wheels is on the central axis of the robot, beside the brush or the dustpan. However, this placement is not applicable with the original cleaning parts, and the motors were placed at the back. This configuration is expected to be more complex to control, and the robot

will require a large area. However, the direct connection between the motors and the wheels without any chain or additional gears reduces odometer errors due to twisting angles in the mechanical parts. In addition, a third wheel (self-cleaning ball transfer) was placed beneath the dustpan to avoid excessive brush pressure.

IV. HARDWARE REQUIREMENTS

- **ARDUINO**

Arduino is a microcontroller board used for controlling the process of our project which consists of multiple input and output pins with the help of them we can feed the required input through programs and obtain the desired output, Arduino is fast, simple, and easy to use.

- **MICROCONTROLLER – ATMEGA8**

The microcontroller we used is Atmega8 it a low-power CMOS 8bit microcontroller based on the AVR RISC Architecture, it is used to obtain precision output signals, count external events, or measure parameters of input digital signal.

Features :

- High-performance, Low-power AVR® 8-bit Microcontroller
- Advanced RISC Architecture
- High Endurance Non-volatile Memory segments
- I/O and Packages
  - 23 Programmable I/O Lines
  - 28-lead pdip,32-lead TQFP, and 32-pad QFN/MLF
- Operating voltages
  - 2.7 - 5.5V (Atmega8L)
  - 4.5 – 5.5V (Atmega8)
- Speed Grades
  - 0 – 8 MHz (Atmega8L)
  - 0 – 16 MHz (Atmega8)

- **DC Motor**

Generally dc current motors are used in all industrial applications and any current applications because it gives better result to ac current. So in this dc current motor is used. Dc motor produce continuous movement and whose speed of revolution can easily be control it makes them ideal for all kind application. The system is run by a DC motor. This motor main functionality involves the moment of the robot and the rotation of the brush. The specifications of the DC motor used are power of 60 rpm. Dc motor consists of mainly two parts. Dc motor one part is called stator and another one is called rotor. Stator is stationary one and rotor is a rotating one.

Parameters	Specifications
Nominal Voltage	12V
Nominal Power	50W
Nominal Current	1.0-1.5A
High Speed	75-76 rpm
Low Speed	50 rpm
Noise	No gear noise
Rotational Output	CW/CCW

Table 1 : DC Motor specification

- **IR SENSOR**

An infrared sensor (IR) is an electronic component, which emits to sense some aspects of the surroundings. An infrared sensor can calculate the heat of an object as well as detects motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our naked eyes, that can be detected by an infrared sensor. The circuit of IR sensor consists of few necessary components they are

- LM358 IC 2 IR transmitter and receiver pair.
- Resistors in the range of Kilo-ohms.
- Variable Resistors

- LED (Light Emitting Diode)

➢ **L293D MOTORDRIVERMODULE**

L293D is a Motor Driver IC that allows the DC motor to drive in any direction. This Motor Driver IC consists of 16 Pins which are used to control a set of two DC motors instantaneously in any direction.

The motor behavior will be based on the input conditions will be as follows:

INPUT 1	INPUT 2	ENABLE 1,2	Result
0	0	1	Stop
0	1	1	Anti-clockwise rotation
1	0	1	Clockwise rotation
1	1	1	Stop
0	1	50% duty cycle	Anti-clockwise rotation with half speed
1	0	50% duty cycle	Clockwise rotation with half speed

Table 2 : Motor behavior based on the input conditions

➢ **BATTERY**

A battery is a component that converts chemical energy directly to electrical energy. It consists of few voltaic cells; each voltaic cell consists of two half-cells connected in series by a conductive electrolyte containing anions and cations. The battery is used to generate the power required for the circuit and the motion of motors.

There are two kinds of batteries available in the market one is primary battery which is also called as disposable batteries and other is secondary battery which is also referred as rechargeable batteries, but for this project secondary batteries is used because is more cost efficient and can be recharged and used again and again

Type	Voltage regulation	Max current
Standby use	13.6v - 13.8v	2.16Amps
Cycle use	14.4v – 14.8v	2.16Amps

Table 3 : Constant Voltage Charge

Parameters	Specifications
Voltage	12v
Current	7.2Ah
Valve regulated type	Lead acid battery
Works	2hours

Table 4: Battery Specifications

V. PROGRAMMING/CODING

The heart of our project is the Programming part which is dumped into the microcontroller which gives instructions to each part and allows each part to perform effectively, the codes we have used in our project has been given below

STEPPER MOTOR CODE

```
#include<stepper.h> //include the header file
// change this to the number of step on your motor
#define STEPS 32
stepper stepper(STEPS,8,10,9,11);
int val = 0;
void setup(){
Serial.begin(9600);
stepper.setSpeed(200);
}
```

INFRARED SENSOR CODE

```
int IRSensor = 2; //connect irsensor to arduino pin 2
int LED = 13; // connect led to ardino pin 13
void setup()
{
pinMode (IRSensor, INPUT); // sensor pin INPUT
pinMODE (LED , OUPUT); //led pin OUTPUT
}
void loop()
{
```

```
void loop() {
if (Serial.avilable()>0)
{
val = Serial.parasein();
stepper.step(val);
Serial.println(val); //for debugging
}
}
```

```
int statussensor = digitalRead (IRSensor);
if (statussensor == 1)
digitalwrite(LED , LOW); // LED LOW
}
else
{
digitalwrite(LED , HIGH); // LED high
}
}
```

POWER SUPPLY CODE

```
#include<SoftwareSerial.h>
SohtwareSerial
mySerial(0,1);
int ledpin=12;
int Data;
void setup()
{
mySerial.begin(9600);
pinMode(ledpin.OUTPUT);
}
void loop()
{
if (mySerial.avilable())
{
Data=mySerial.read();
if(Data=='1')
{
digitalWrite(ledpin.HIGH);
mySerial.pirintln("LED" On!");
}
else if (Data=='0')
{
digitalWrite(ledpin,LOW);
mySerial.println("LED Off!");
}
}
}
```

MOVEMENT MOTOR CODE

```
int A=8;
int B=9;
int C=10;
int D=11;
char a;
void setup() {
 pinMode(A, OUTPUT);
 pinMode(B,  OUTPUT);
 pinMode(c, OUTPUT);
 pinMode(D, OUTPUT);
Serial.begin(9600);
}
void loop() {
if(serial.avilable() >0)
{
a=Serial.read();
Serial.println(a);
if(a=='R')
{
Serial.println(a);
digital.Write(A,0);
digital.Write(B,0);
digital.Write(C,0);
digital.Write(D,0);
}
if(a=='L')
{
digital.Write(A,1);
digital.Write(B,0);
digital.Write(C,0);
digital.Write(D,0);
}
}

}
```

MOTOR DRIVER CODE

```
int a=13,b=12,c=10,d=9;
void setup()
{
pinMode(a,OUTPUT);
pinMode(b,OUTPUT);
pinMode(c,OUTPUT);
pinMode(d,OUTPUT);}
void loop() {
front();
void front(){
digitalWrit(a,HIGH);
digitalWrit(b,LOW);
digitalWrit(c,LOW);
digitalWrit(d,HIGH);
}
void back();{
digitalWrit(a,LOW);
digitalWrit(b,HIGH);
digitalWrit(c,HIGH);
digitalWrit(d,LOW);
}
void left(){
digitalWrit(a,HIGH);
digitalWrit(b,LOW);
digitalWrit(c,HIGH);
digitalWrit(d,LOW);
}
void right(){
digitalWrit(a,LOW);
digitalWrit(a,HIGH);
digitalWrit(a,LOW);
digitalWrit(a,HIGH);
}
}
}
```

VI. BLOCK DIAGRAM

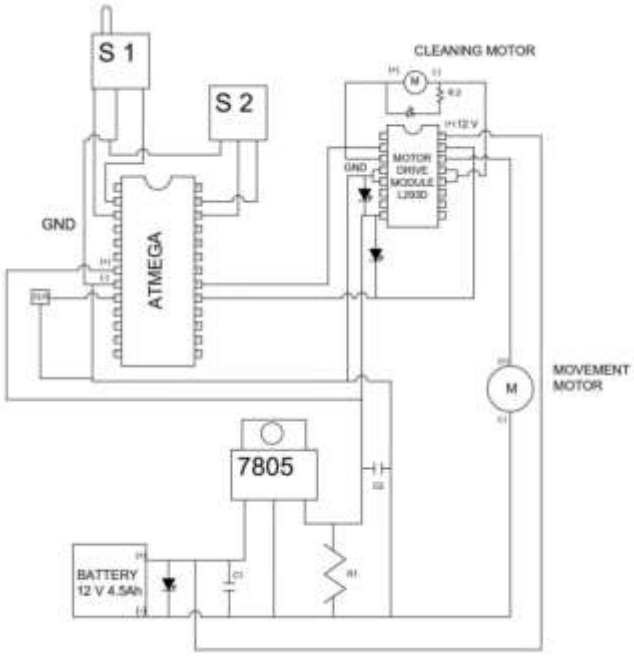

Figure 2 : Block Diagram

VII. WORKING

The project consists of two 6v batteries, voltage regulator, motor driver, 2 dc motor,1-Atmega processor, 2 IR sensor,4 wheels & 1 cleaning brush.

The two 6v batteries are connected in series connection and form 12v power thus the one end of the battery is connected to the switch and another end is connected to the voltage regulator, The voltage regulator is straightly connected to the motor driver which operates the 2 DC motor, The connection of motor driver is connected to the dc motor where one motor is for the moment of wheel and another motor is for the moment of brush for the cleaning purpose, The another main part of the project is the Atmega-8a processor, which controls the 2 –IR sensor and the Atmega-8a processor is feed with coding for all the working parts, one IR sensor is for detecting the obstacles and another is for detecting the end part the drainage.

Once the IR sensor detects any kind of obstacle the code executes and the first motor which is connected to the brush starts functioning and clears the obstacle its way later again starts sensing for obstacle when no obstacle detected by the IR sensor the robot moves forward, the process is repeated till it reaches its endpoint and when the endpoint is near the second IR sensor detects the endpoint and starts returning backward and reaches the starting point.

VIII. DISCUSSIONS

While conducting the experiment the parameters considered are uniform flow rate of water, depth of the channel is 1feetand height of the channel is 3feet, rate of disposal of waste is in uniform manner, lifter speed and motor speed is constant. The cost of the machine is economic and it requires only12-24 volts of current.

These cleaners are the cheapest way to fix drainage problems. Easy to operate and control as no special skill is required. Reduction of a labor-oriented method of cleaning, thus Upgrading dignity of labor. Lightweight and easily portable. A large amount of garbage will collect which can be remanufactured.

IX. CONCLUSION

Now we can conclude that with the help of our project AUTOMATED DRAINAGE CLEANING ROBOT that:

- We can apply this project in distant and slum areas with effectiveness.
- Since drains are linked with hygiene and in slum areas this is a major problem and we can apply this project in those areas and can safeguard the health of the people.
- Our project is very useful in the monsoon because in the rainy season our drains are usually are overflowing and they can be blocked by solid wastes.
- We can incorporate this project with SWACHH BHARAT ABHIYAAN which is a revolution in present times.
- We can say that in India our drains and sewage paths are open so this project or mechanism can become very handy and use to clean them.

Our project is very easy to operate since we are using this mechanism to generate electricity to drive the mechanism itself (self-driven) and is very easy to maintain.

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