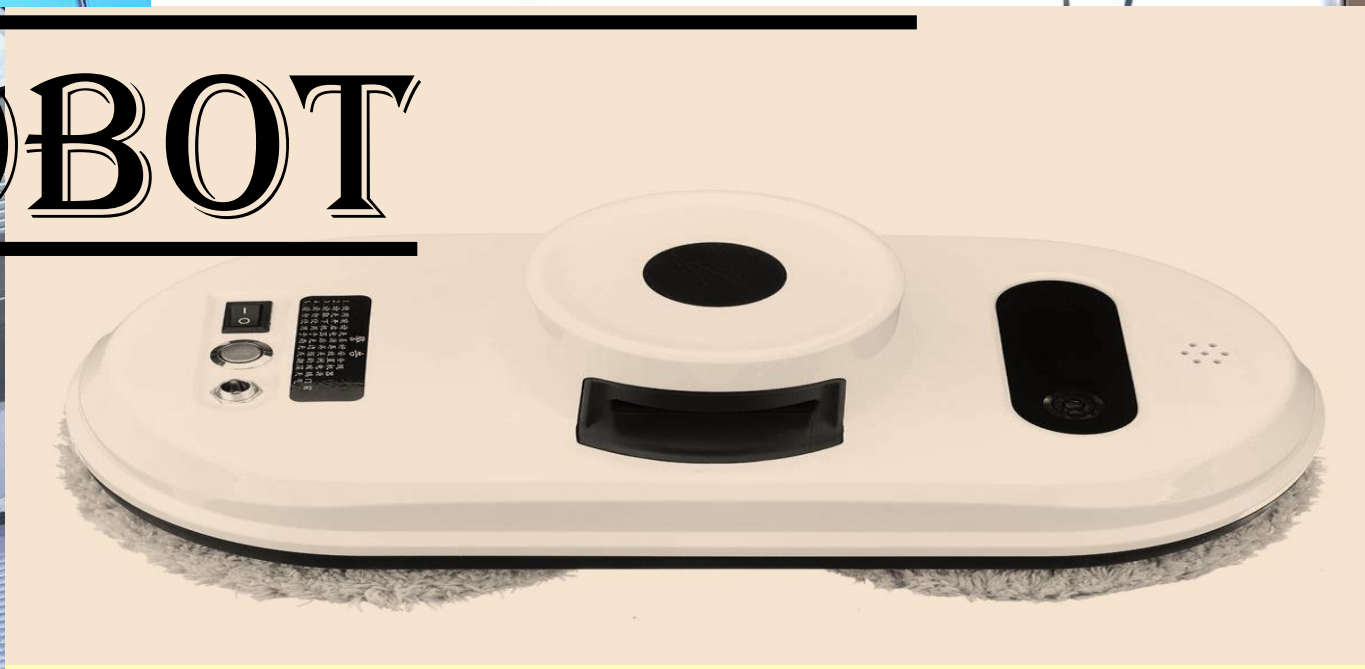
OUTSIDE WINDOW GLASS CLEANING ROBOT



CONTENT :

ACKNOWLEDGEMENT :

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Outmost thanks to our family ,not forgetting their eternal moral support and understanding of our academic responsibilities.

Also, I would like to express my gratitude to my friends, especially to all my course mates who have helped us technically and mentally during the journey to accomplish this project. Thank you all for giving us technical advice, moral support and idea to enhance our project.

--Thank you

INTRODUCTION :

Cleaning is routine in our life. Maintaining a clean living and working environment is an important means to ensure people's quality of life. Window cleaning is also one aspect of maintenance repair and cleaning activity due to excessive dust and pollution in the city.

The conservative method for external maintenance such as the use of rope(scaffolding), gondola and a winch or a mobile elevated work platform,require experienced labours for safety precaution. The more dependent on human labour, the more risk be able to occur where they are inherently danger, and cause emergency conditions when earthquake or wind gust occurred. Meanwhile at home, the human still exposes to the risk of being cut, hurt and injury due too high or any sharp objects on the surface of glass walls.

Consequently, the demand for an external window cleaning robot had arisen. In this project, the machine is designed to overcome the above problem and to reduce the labour cost.

Based on the results of interdisciplinary fields like mechanics, electronics and informatics ,the autonomous mobile robots are gaining more and more attention. The methods used for movement, actuation and none the last the ability to operate in unknown and dynamic environments give them a great complexity and a certain level of intelligence.

Thus, this project propose to develop an automated, simple and light-weight cleaning robot that is practical to a modern house using a cost-effective microcontroller of Arduino as the brain of the robot. A project using Arduino gain huge interest not only for researchers, but also for university and school project due to flexibility, cheap and free Arduino software that is available on their website.

PROJECT METHODOLOGY

OBJECTIVES :-

The main objective of this project is to design an automatic mechanical device used in cleaning the window glass panels in a building.The project is conducted to achieve the following objectives:-

a) To design a small cleaning robot for office window and glass that is portable, small size, lightweight, automatic operation and can clean all the corners of the office window and glass.

b) To write the software program for the glass cleaning robot.

c) To build the electrical part of the glass cleaning robot i.e circuit connections .

d) To build the mechanical part of the glass cleaning robot i.e. frame for holding the system.

e) To assemble and testing of the glass cleaning robot that can be operated on the glass window.

PROBLEM STATEMENTS :

Two main points that are stressed in this project are to overcome the hazard of human involvement in cleaning window activity and reduce high cost by the conventional method of cleaning window. It becomes necessary to overcome the limitation. The project will help to replace or minimize human involvement in cleaning the window by replacing it with a small glass cleaning robot with several capabilities.

Certain Problem Statements and the Solutions Approached:

1.Cleaning the window

We have used wipers, a water tank and water sprayers attached to an integrated pulley system to clean the window which is controlled by a programmed Arduino microcontroller .

2.Managing the altitude of the window from the ground

We have used a stepper motor controlled Pulley system for managing the height upto which the system can clean the window.

3.Automating the pulley system and water pump

In our prototype, the entire pulley system and the water tank as well is automated by using a stepper motor which itself is controlled by an Arduino Uno Microcontroller coded in C++ language.

3.Moving the entire system horizontally

For now we have used Wheels at the base which could be automated using remote control system at a later stage.

4.Portability of the system

Although the initial prototype designed is made of wood base , wheels and aluminium rods seems to be enlarged ,but practically it is easily possible to make the entire system highly compact and portable using hydraulic rods , pneumatic cups and scissors lift systems as substitutes which currently due to time ,access and budget has been restricted.

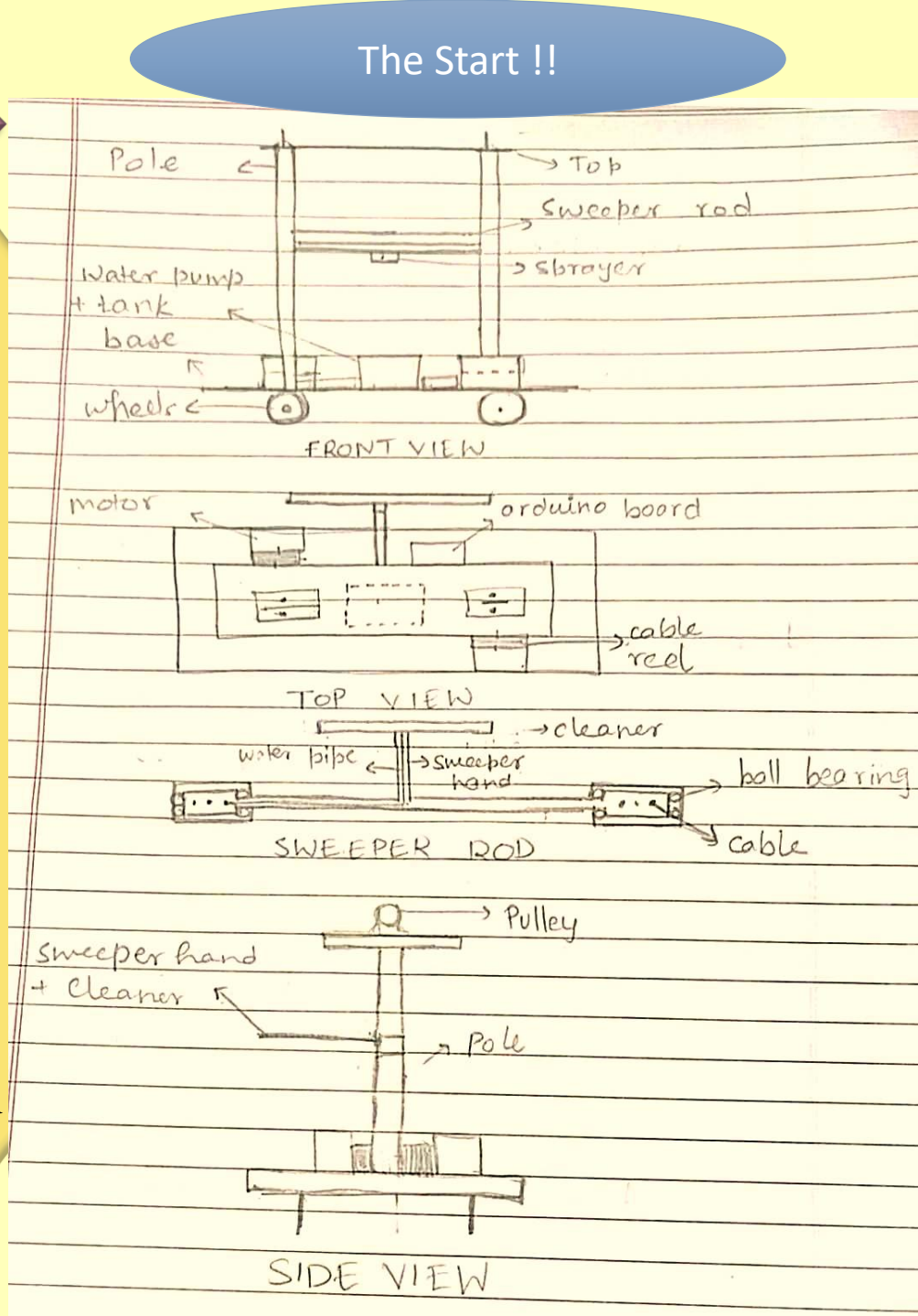
COMPONENTS AND MATERIAL USED :

SL. NO.	ITEM NAME & SPECIFICATION	QUANTITY	JUSTIFICATION
1	Arduino	1	Arduino-UNO
2	Wheels	4	For the base
3	Aliminium rods (sqaure- 2.9 ft)	2	For supporting the pulley+belt system
4	Plywood base (2*2 ft)	1	For acting as the base
5	13 ft Belt	1	For pulley
6	Stepper Motors	2	Single shaft stepper motor
7	Wiper	1	For cleaning purpose
8	Thin water pipes	2	To sprinkle water
9	Pulleys (radius-1.6cm)	6	For the pulley system
10	L-clamps	6	For fixing the rods
11	Water tank	1	For water storage
12	Water pump	1	Diaphragm Based mini Aquarium Water Pump
13.	Fevicol, screws, nut bolts		For various joints and circuits

PROTOTYPE DESIGN :

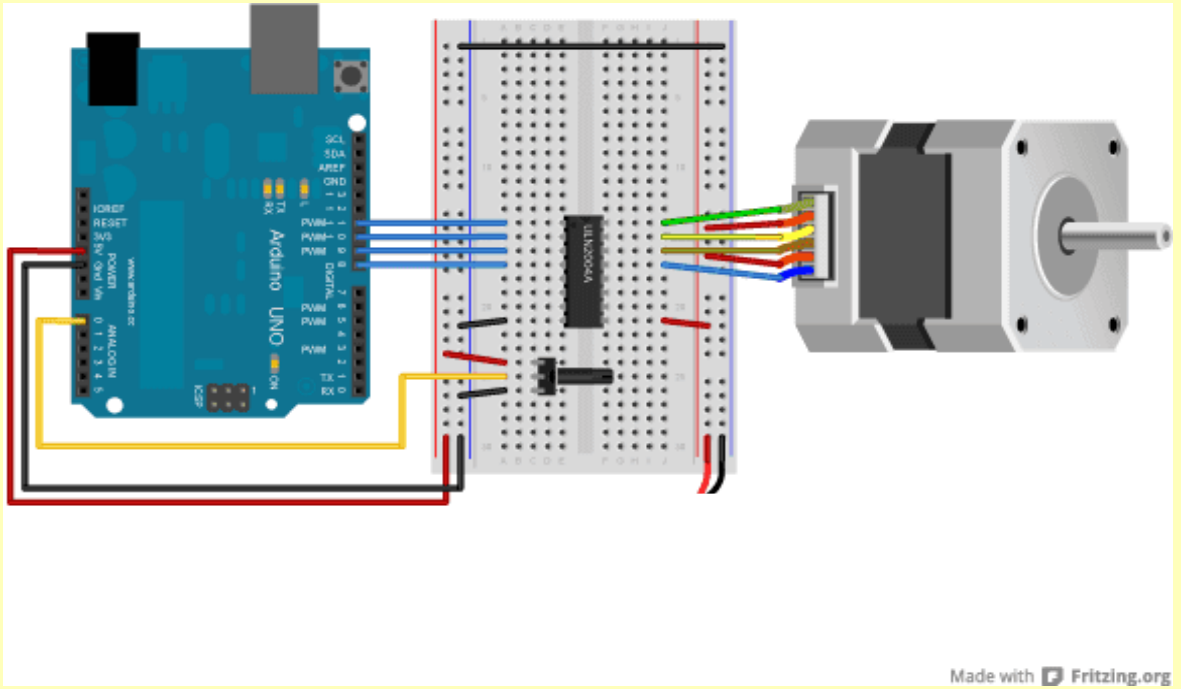
The structure of the proposed device consists of a rectangular frame ,which in turn, consists of an automated cleaner attached to a pulley system which is run by motors and pre- programmed microcontrollers. The automated cleaner ,consisting of a wiper and a sprayer which moves in the vertical direction within the frame. To support the 4 pulleys ,2 square aluminum rods are used as frame, which is held firmly to a 2*2ft plywood base using L-clamps .All other components ,such as the arduino board, water tank ,stepper motor and so on are placed on the wooden base. Also the base is attatched to 4 rotating wheels for proper horizontal motion of the system.

Initially, the rough drawing and dimensions were drawn.After which each components were bought separately and finally assembled together as planned. While designing a glass cleaning machine, some assumptions are considered which is standard for their parts. Safe design for this machine by calculating the dimensions of each part and considering formulations. Material selection based on availability, durability, cost and ease of fabrication were also considered.

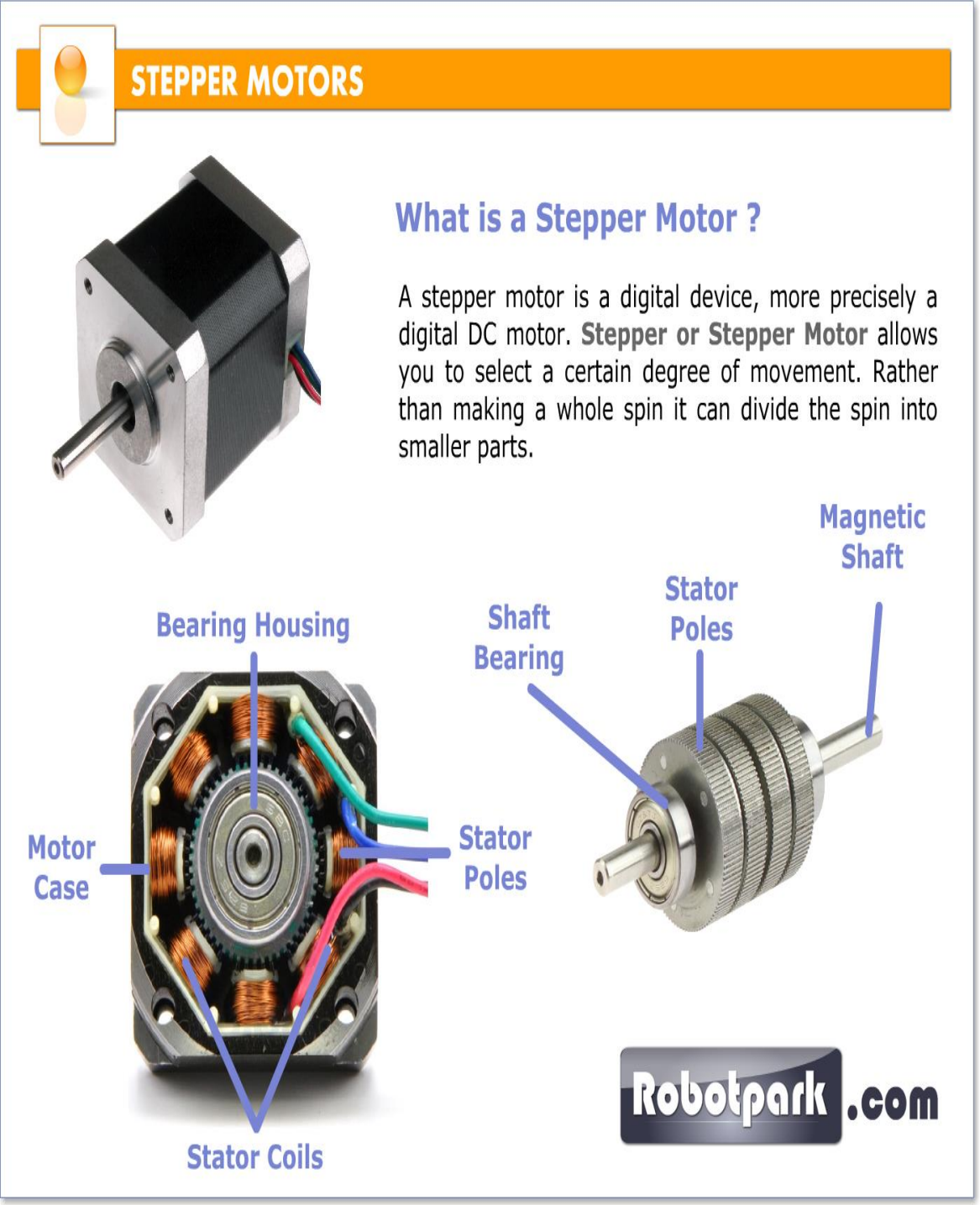


WORKING PRINCIPLE :

This project is divided by two sections; software and hardware. The software used is Arduino Uno microcontroller which is programmed efficiently in C++ language which controls the Stepper motor and the water pump . The stepper motor in turn controls the pulley system such that the horizontal rod consisting of wipers and sprayers is able to execute vertical motion across the given window. The code describes how the robot will be executed based on command given, acting as the brain of microcontroller.



After this simulation succeeded, the project is continued to the hardware section,where square aluminium rods, fixed to wooden base , supports the pulley system,consisting of 4 pulleys connected by stainless wires. The cleaning of the window is done using a wiper and water sprayer (made using multiple holes in pipes) ,which is connected to a water pump while water is stored in a water tank.



TESTING :

Before the final assembly of the components , the successful testing of the code implemented through Arduino microcontroller, to control the stepper motor is done . Also the working of pulleys and wheels are also checked. Furthermore , the functionality of the water pump and pulley system is also thoroughly gone through.

Also , once the final prototype is ready , the entire working of the project is also tested and proven to be successful.

PRODUCT GENERATION :

The final dimension of the outside window cleaning robot system is 2ft*2ft*2.9ft .

ADVANTAGES :

Such automated window cleaning machines have a wide range of advantages.

1.It can be a replacement for the GONDOLA system for high-rise building cleaning.

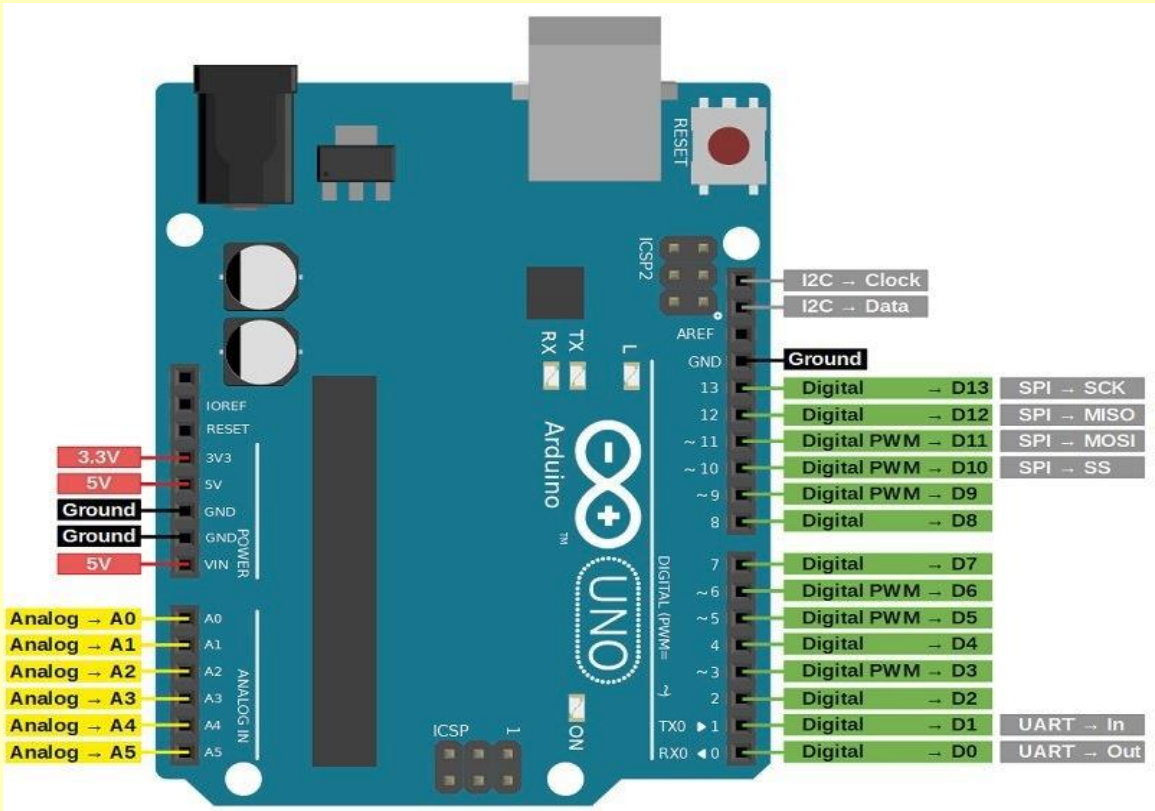
2.It reduces labour cost.

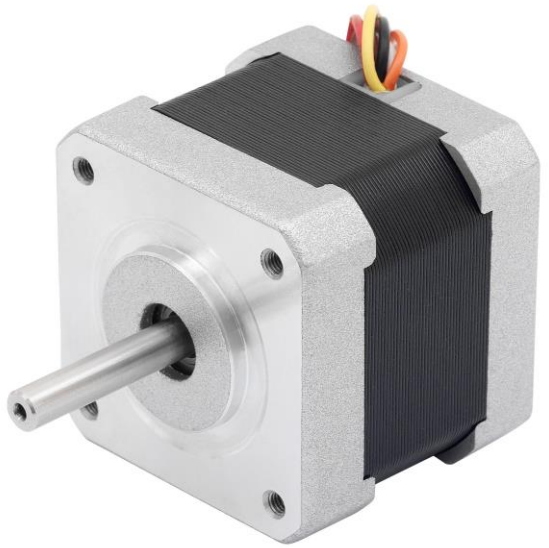
3.It is far more safe than traditional human methods of cleaning outside glass windows.

4.It has higher efficiency.

5.Other than cleaning ,such prototype systems with some slight further modifications can also be used for other purposes such as wall painting, monitoring the conditions of the glass walls etc.

6.Arduino as the brain of the project is comparatively cheap.





CONCLUSION :

A strong multidiscipline team with a good engineering base is the key for completion of the project.

In concluding remarks of our project work,we are proud that the “outside window glass cleaning robot” is successfully working with satisfactory conditions and the project is completed within the limited time efficiently.

The final design in this project incorporates traditional items and systems, and transforms them into a final product that is reliable, innovative, and practical. From analysis done, the robot concept is proved applicable for the desired functionality. Since the design is only a proof of concept and therefore the actual cleanliness of the window is less of a concern than the risk and ease of use, and controllability of the final product. The project is seen practically achieve its project scope and objectives to come out with a functional outside window cleaning robot .

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We learned a lot of practical knowledge regarding, planning , purchasing , assembling , and machining while doing this project work . It has done to our ability and skill making maximum use of available facilities. We hope that with further extension of knowledge we would be able to make a commercial product from this prototype.

BIBLIOGRAPHY :

The project has been successfully completed within the given time by gathering information from the following sources:

1. https://www.robotique.tech/robotics/control-a-water-pump-by-arduino/

2. https://docs.arduino.cc/learn/electronics/stepper-motors

3. https://www.researchgate.net/publication/326538175_

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--Thankyou