Arduino-based Automatic Whiteboard Cleaning System

Md. Tanvir Mahtab, Nayeem Hasan Moon

Md. Jobayer Abedin, Sumaiya Rahman Eva

Sumaiya Sultana

Abstract: This paper is about the design of an IR controlled Arduino based automatic whiteboard cleaner. Here the microcontroller based system design software called Proteus is used. Different modules used to design the system include Arduino uno, CNC shield, Stepper motor, Servo motor, IR sensor and remote. The paper is divided into eight sections which are introduction, literature review, block diagram of the system, Brief description of the components used for the design, schematic diagram of the system, working procedure, simulation and results and conclusion.

Keywords: Arduino Uno, Proteus, Stepper motor, whiteboard, Servo motor, IR remote.

I. Introduction

Whiteboard is a very important thing in today's world not only in the academic arena but also in many other instructive and communication sectors. The traditional whiteboard cleaning method typically involves a duster which the user has to use thyself to clean the board. Sometimes this process takes a significant amount of time which otherwise could be invested in a more productive way. Besides, frequently the hands of the user comes with the contact of the marker ink which might contain some detrimental chemicals like Xylene. Therefore, an automatic whiteboard cleaner can be of great use in this case. This paper aims to design such a system using Arduino which would be controlled by the IR remote controller.

II. Literature Review

The whiteboard cleaning system proposed by S. Joshibaamali and K. Geetha Priya can work in three different modes. It cleans the left side, right side and whole area of the board in the first, second and third mode respectively. Two stepper motors are used by the system for the horizontal and vertical movement. Here a dsPIC30F401 microcontroller is used as the main microcontroller [1].

In the system proposed by Sonia Akhter et al. a sonar sensor is used to sense the distance and time specified by the Arduino. Therefore, the motor rotates in both clock-wise & anti-clockwise direction [2].

In their paper Nay Yee Win War and Zaw Myo Tun proposed to use two stepper motors, two servo motors and an A4988 driver. The used Arduino as their main microcontroller [3].

III. Block Diagram of the System

The functional block diagram of the system is as follows-

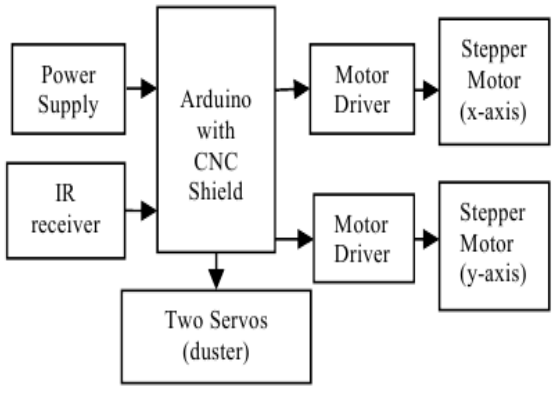

Figure 1: Block diagram of the automatic whiteboard cleaner.

When the user switches on the supply, current is passed to the 12V adapter and then it passes through Arduino Uno. IR sensor is connected to Arduino to receive the input serial data from the user. When the user presses the button on the remote, it transmits a unique decimal value to the IR sensor. CNC shield can be plugged on top of the Arduino which will provide more flexibility. An A4988 is used to drive the stepper motor. Motors can go forward and reverse direction by the control of the Arduino. CNC shield and A4988 driver is used for over-current and over-temperature protection. Stepper motor has a good precision than the other motor. Two Steppers are used for moving the duster in X-axis and Y-axis directions. For balancing the duster, servo motor can press the duster. This system can work with various instructions. It can clean left side, right side or all area of the whiteboard. The user can easily choose for cleaning the desired area.

IV. Brief Description of the Components Used for the Design

A. Arduino Uno microcontroller

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analogue inputs, a 16MHz quartz crystal, an USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; a user simply needs to connect it to a computer with an USB cable or power it with an AC-to-DC adapter or battery to get started [4].

B. Stepper motor

A stepper motor is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any position sensor for feedback (an open-loop controller) [5].

This system uses two stepper motors to move the duster in horizontal (X-axis) and vertical (Y-axis) direction.

C. A4988 driver

Simple step and direction control interface. Stepper motor driver lets for control one bipolar stepper motor at up to 2A output current per coil. It operates from 8V to 35V and can deliver up to approximately 1A per phase without a heat sink [6].

D. CNC shield

The CNC shield is designed to control a CNC or a 3D printer. It comes with 4 sockets A4988 stepper driver. This board has Arduino pin connections and pins for engine and other peripherals. Shield allows external power supply up to 36V for powering powerful motors [7].

E. Servo motor

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear 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. Servomotors are not a specific class of motor although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system [8]. In this system, servo is used to press the duster.

F. IR Sensor TsoP738

IR sensor component is made up of a pin diode and a pre amplifier which are merging into a single device. Generally the

output of the sensor is active low and it provides +5V in off state. When IR remote generates a signal at the frequency of 38 kHz, its output goes low.

This mini slim infrared remote is controlled with 20 function keys. Its transmission distance is up to 5 meters [9].

V. Schematic Diagram of the System

Depends on the simulation part (have to insert later).

VI. Working Procedure

The flowchart of the system is shown in Figure 2 which represents the sequenced processes and steps taken to carry out specific action with the application.

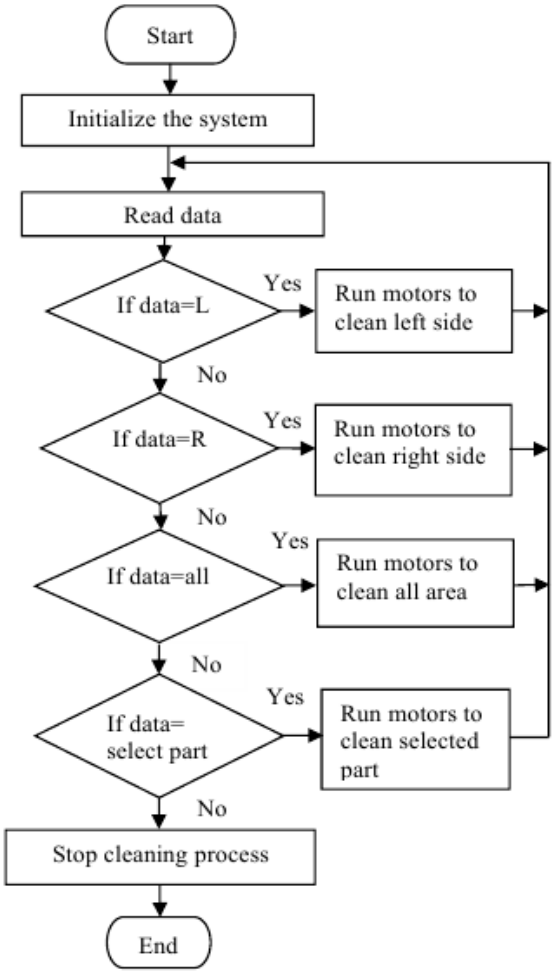

Figure 2: System flow chart.

When the system is started, all components are ready to use. Arduino Uno waits for the code number from the IR remote controller. When the remote controller produces and sends the code to arduino uno, the motor starts working as per the instructions shown in Figure 3.

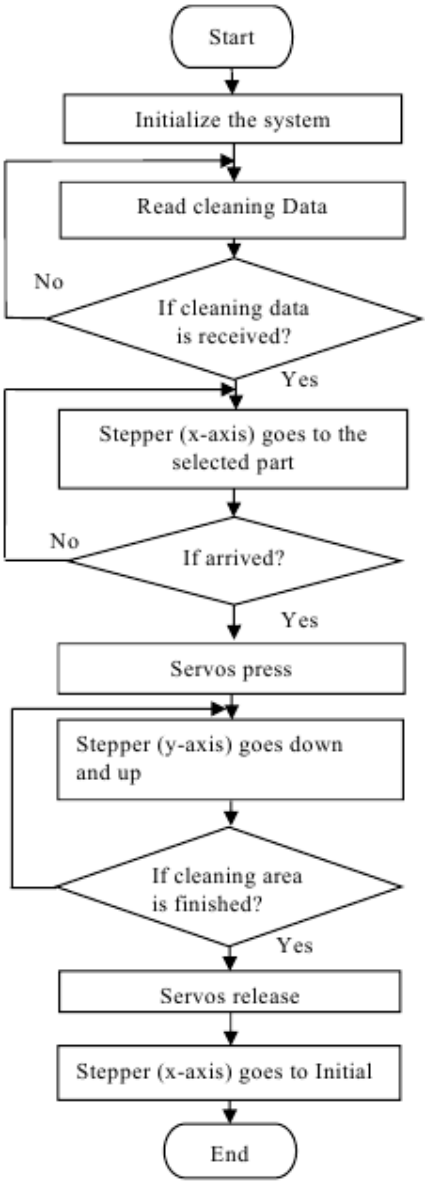

Figure 3: Program flow chart of motor control system for cleaning process.

The system can clean the whole area of the whiteboard as well as either left or right part of the whiteboard according to the instruction of the user.

VII. Simulation and Results

Depends on the simulation part (have to insert later).

VIII. Conclusion

The Arduino-based automatic whiteboard cleaning system proposed in this paper is currently in the design level. The overall discussion and findings on this design suggests that it is feasible enough to be implemented. Thus the intended product based on this design is supposed to be a contributor to reduce the overhead of traditional whiteboard cleaning mechanism in some extent.

References

[1] Sonia Akhter, Anindo Saha ,Md.Rayhan Parvez koushik, Md. Asaduzzaman, Razoana Islam Shorna, Md.Moudud Ahmed "Automatic Whiteboard Cleaner Using Microcontroller Based Rack and Pinion Mechanism" *International Conference on Mechanical, Industrial and Materials Engineering 2015 (ICMIMME 2015) 11-13 December, 2015, RUET, Rajshahi , Bangladesh*.

[2] S. Joshibaamali And K. Geetha Priya, "Automatic Duster Machine", *International Journal Of Emerging Technology In Computer Science & Electronics (IJETCSE) ISSN: 0976-1353 Volume 13 Issue 1 –March 2015*.

[3] Nay Yee Win War and Zaw Myo Tun, "IR Controlled Automatic Whiteboard Cleaner Using Arduino", *International Journal of Science, Engineering and Technology Research (IJSETR) Volume 8, Issue 6, June 2019, ISSN: 2278 -7798*.

[4] https://store.arduino.cc/usa/arduino-uno-rev3

[5] http://osoyoo.com/2017/04/07/arduino-uno-cnc-shield-v3-0-a4988/

[6] https://en.wikipedia.org/wiki/Stepper_motor

[7] https://www.robotshop.com/.../datasheet-...

[8] https://www.elprocus.com/servo-motor/

[9] https://www.makerlab-electronics.com/product/arduino-ir-remote-control-kit/