Design and Implementation of Mini Car Washing

Cho Thet Nwe[1], Ma Naing[2]

[1]Assistant Lecturer, [2]Lecturer
[1]Department of Electronic Engineering, Technological University, Kyaukse, Myanmar
[2]Department of Electronic Engineering, Technological University, Magway, Myanmar

ABSTRACT
In this paper the author wants to explain design and implementation of the automatic mini-car washing system with sensors and CorelDRAW computer software. Arduino microcontroller is the main control unit of the system and this system is fully automated with different stages such as washing, cleaning and drying. It also contains emergency shutdown system (ESD) for dangerous conditions such as fire, gas, and avoidance, and this system is designed with flame, gas and infrared sensors. The main purpose of this paper is to develop automatic car washing system without manual labour. The system has the ability to identify and profile geometrical dimensions of the vehicle chassis. Vehicle dimension identification is an important point in this system to adjust the washing brushes position and time duration. The result of this system indicates that the proposed method in process control not only increases productivity, speed, accuracy and safety but also reduces the time and cost of washing.

KEYWORDS: Arduino uno, nano, Sensor, Motor, CorelDRAW

I. INTRODUCTION
Car washing is an essential function of preventive maintenance. Automatic car washing is simple activity done in order to keep the exterior of the car clean. Mostly, it is used manually in automobile garage or service centers of automotive companies.

This manual way of cleaning car results in more consumptions of water, manpower and time. The main idea for this paper is to design and construct automatic car washing by using Arduino and sensors. Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board and a piece of software, or IDE (Integrated Development Environment) that runs on computer, used to write and upload computer code to the physical board. Automatic car washing consists of tunnel-like building into which customers drive. Many full service car washes also provide "detailing" services, which may include polishing and waxing the car's exterior by hand or machine, shampooing and steaming interiors, and other services to provide through cleaning and protection to the car. There are three processes involved in automatic car washing system namely washing, cleaning and drying. Using automatic car washing system, many cars can be washed and it will save time, energy and man power.

II. System Overview
In this thesis, automatic car washing system is composite with Arduino boards, sensors, motors, water sprinklers, fan and power supply system. The material of the automatic car washing is designed using fibreboard. In a car washing system, washing is a primary stage. In the first stage, car is to be washed by water necessarily to remove dust or mud from the outer body and from wheels of car. This process is done manually in service stations. In this automatic system, when the car is sensed by the LDR sensor, the mini-water pumps will be opened then water will be sprayed on the car. There are two mini-water pumps used for washing with water and washing with foam in this automatic car washing system. After being washed with foam, the car is washed with water to remove the excess soap and water. After washing process, the next process, cleaning starts. In cleaning, car is sensed by the sensor and the mechanism of motor with curtain is use for cleaning. A set of horizontal brushes wash the top, front and rear of the vehicles. Two sets of side brush wash the area around the vehicles, and another set of wheel brush cleans the wheel. The water rinses away.
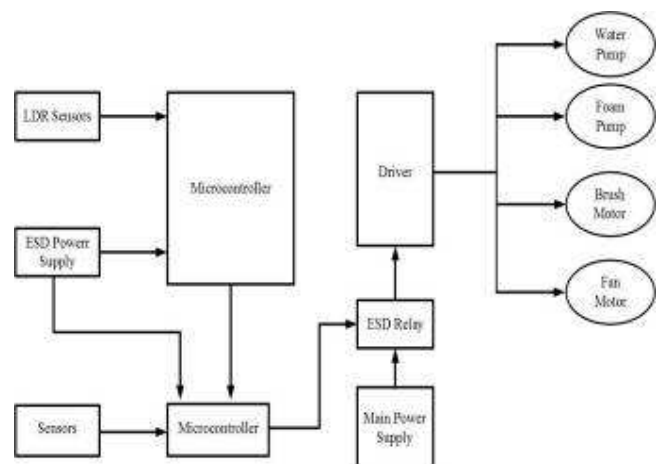

Figure1. The System Block Diagram

III. System Design
The design of automatic car washing is considered before construct the vehicle. The design is considered as automatic

car washing with components, torque, size and specific dimension. Design drawing is very important with specific dimensions. From calculations, CorelDRAW computer software is used for automatic car washing design drawing. The design of the structure is an engineering systems problems that incorporates technical, production, and logistic constraints. The design objectives were to: minimize manufacture labour; improve transportation and installation strategies and reduce weight and size. The design considerations are very important and what type of material made is more important. According to designer's needs, one can choose desired materials. Automatic car washing is constructed with fibreboard. Fibreboard is very suitable this project because it is very hard, lightweight and inexpensive.

Figure2. The Main Frame of Automatic Car Washing with Fibreboard

Figure3. Based of Automatic Car Washing

The first step construction of automatic car washing is side frame and servo motor MG996R to move the vehicle with rack and pinion gear. Side of automatic car washing are length 34.8cm, height 15.5cm and the distance of inner side and upper side are 5cm. The distance between left inner side and right inner side is 18cm and each side has two interlink frame.

Figure4. Installation of Two Sides on the Base

The roof of automatic car washing is squarish design and dimensions are length 24.8cm and width 28cm. Two servo motor MG995 with gear wheels are installed on the inner of roof. The interlink frame are connected to the gear wheel and brush motor and servo motor is perform to adjust the brush with the size of car. The air-fan which performs to dry the washing car, is fittingly installed on the roof. Water pipe from mini-water pump are also installed on roof with hole.
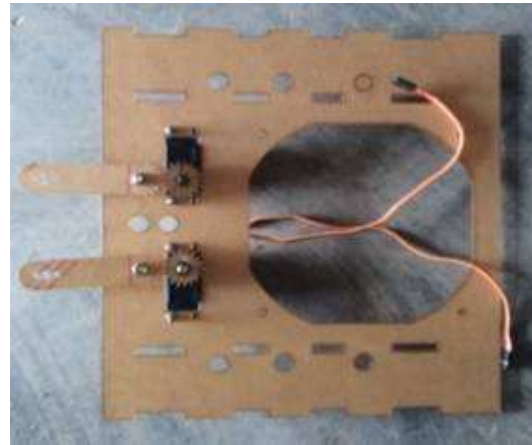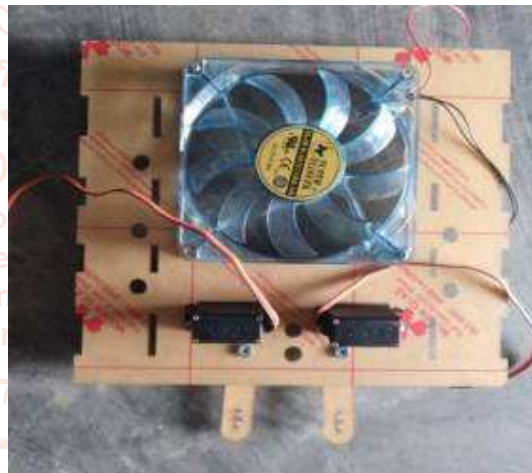

Figure5. Roof with Servo Gear and Interlink Frame

Figure6. Top view of Roof with Servo Motor and Fan
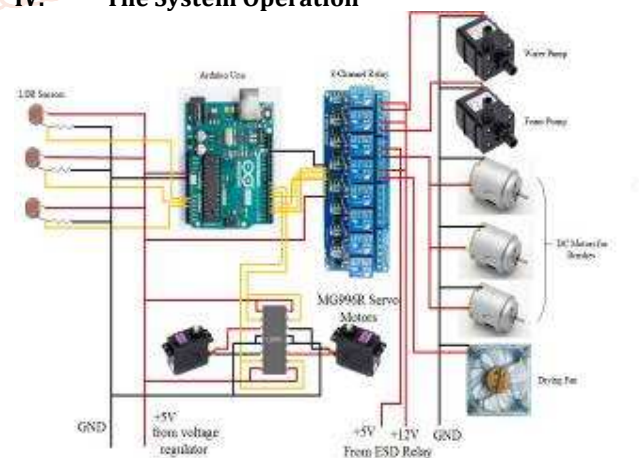
IV. The System Operation

Figure7.Circuit Diagram for Main Control

In this system, three LDR sensors are used to check the existence of the car in automatic car washing. Each LDR sensor has two pins. One pin of each LDR sensor is connected to +5V supply pin of Arduino Uno. And another pins of each LDR sensor are connected with three 100kΩ

resistors respectively. Then these three signal pins which connected to three resistors are joined with Arduino Uno pins A0, A1 and A2 respectively. And other three pins which connected to three resistors are joined with Arduino Uno GND pins. And, the supply pin and GND pin of Arduino Uno are connected to the GND pin and the supply pin of 8-channel relay module. The digital output signal pins of Arduino Uno are connected to the input pins of 8-channel relay module. Two mini-pumps are connected to first and second relays of the 8-channel relay module. Two supply pins of these pumps are connected to the COM pins of first and second relays of 8-channel relay module respectively. Two NO pins of first and second relays are connected with the +12V supply from ESD relay and the GND pins of these water pumps are also connected with GND pin of battery. Three +5V pins of DC motors for brushes are connected to the COM pins of third, fourth and fifth relays of 8-channel relay module respectively. Three NO pins of these relays are connected to the +5V supply from ESD relay and GND pins of these DC motors are also connected to the GND pin of +5V supply from ESD relay. Fan is connected to the 8-channel relay module. The supply pin of the fan is connected with the COM pin of sixth relay module and the GND pin of the fan is also connected to the GND pin of ESD relay module. The NO pin of sixth relay module is connected with +12V supply from ESD relay. Two MG996R servo motors are used in automatic car washing. They are modified by jumping the control circuit of these servo motors. Two supply pins of each servo motor are connected to 3, 6, 11 and 14 pins of L293D motor driver. The data pins, 2, 7, 10 and 15 of motor driver are connected to D6 and D7 pins of Arduino Uno. The GND pins, 4, 5, 12 and 13 of motor driver are connected to GND pin of 5V supply. The enable and VCC pins of motor driver are connected to 5V supply pin.
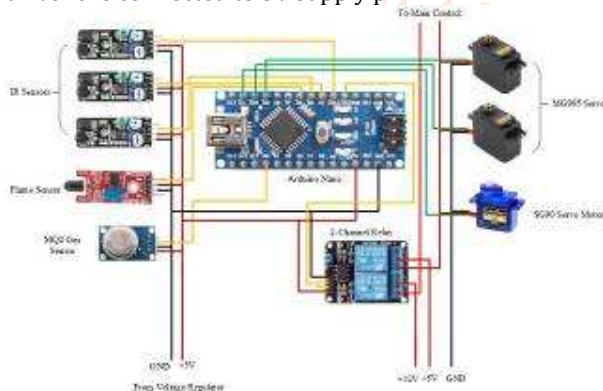

Figure8. Circuit Diagram for ESD Control

For ESD control, the supply pin and GND pins of flame sensor module are connected to the 5V supply and GND pins of Arduino Nano. The digital output pin of flame sensor module is also connected to the digital input pin D6 of Arduino Nano. Next, VCC and GND pins of MQ2 gas sensor module are connected to the 5V supply and GND pins of Arduino Nano. The analog output pin of MQ2 gas sensor is connected to the analog input pin A0 of the Arduino Nano. And, three IR sensors are used in this thesis. The supply VCC and GND pins of these IR sensors are connected to the 5V and GND pins of Arduino Nano. The output pins of these sensor modules are also connected to the digital input pins D3, D4 and D5. Three servo motors are connected with Arduino Nano. All VCC pins of three servo motors are connected to the NO pin of first relay of 2-channel relay module and COM pin of first relay of 2-channel relay module are connected to the +5V supply pin

of 5V battery. All GND pins of three servo motors are connected to the GND pin of 5V battery. The digital pin D2 of Arduino Nano is connected to the input pins of two channel relay module.

V. System Testing

The vehicle movement is tested with the servo motor by using Arduino program. The moving time of the vehicle is adjusted and changed by Arduino program. After testing the vehicle movement, four processes: watering, foaming, brushing and drying are to be tested. The two mini water pumps are also commented by. Arduino program to pump water and foam when the car is in the vehicle to be washed. Testing of brushing is performed with three kinds of brushes such as plastic brushes and silk brushes and clothes. In testing with plastic brushes, the probability of causing scratch is much. Since this thesis is only prototype, it is not easy to get clothes which is smooth and gentle. The silk brushes are most suitable for this automatic car washing. That is why, these brushes are gentle and smooth. And they cannot cause scratches. Brush waving causes the vibration to the whole vehicle because the stem of the brush does not mesh the shaft of the motor. After adjusting the center of the stem with the shaft, the vibration of the brush and the vehicle can be reduced. For brush testing, silk brushes are used to brush the car. Silk brushes are connected to the motor and ordered by using Arduino program. And the last process, drying the car is tested with a globe fan. After cleaning car, the car is made dry by placing the globe fan over it as long as the car is dry. This globe fan can be dry within five minutes. Arduino and sensors are connected on the circuit board. Firstly, IR sensors are tested and Arduino programs are uploaded to the Arduino board for each sensor. IR sensors operate to avoid the barriers. If one of the IR sensors met the barrier, S LED is ON. P LED is already ON when IR sensor gets power supply from Arduino. In this thesis, the height of the car is limited by IR sensor placed on the top of the vehicle. If the car's roof is taller than the limiting height (15.5 cm), the system will not work. Like this, the IR sensors on both sides of the vehicle limit the wide of the car. If the wide of the car is wider than that of the vehicle, the system will not work too. The limited wide of the car to be washed is 16 cm in this thesis. The presence of methane is sensed by MQ2 gas sensor. MQ2 gas sensor produces 1V to Arduino as soon as the presence of the gas around the vehicle exceeds the limit. Then the automatic car washing system will shutdown automatically. If MQ2 gas sensor does not sense the gas, it will produce 3.3V to Arduino. The next test is with flame sensor called fire sensor. The presence of flame or fire is tested by a flame sensor around. Flame sensor detects the wavelength of fire in the range of 760 nm to 1100 nm.

Figure9. Testing of Automatic Car Washing

VI.   Discussions

These types of automatic car washing have been criticized for being too rough on a vehicle's exterior and may actually grind dirt and debris into the paint causing scratches and imperfections. When visiting this type of washing facility, about the quality of components, specifications of components and frame to make sure they are fine for this type of automatic car washing. Emergency shutdown system is the most important system for driver, so this system is included in the automatic car washing. Automatic car washing will have fresh soft brushes for front, back, sides and roof, apply water and foam, then wash with a wash solution and dry the washed car. This type of car washing is great because it is fully automatic.

VII.   Conclusion

In automatic car washing system, we performed the operations needed to clean the car successfully by using Arduino, relay, sensor, motor and water pump. The whole system of automatic car washing is worked the overall process step by step visualization. The demand of the automatic car washing service much high and the people are willing to wash their cars in such a place where their car paint is not damaged. And a better wash is given. The important factors for the customers are to save their time on car washing and to be dry their car as well. This automatic mini car washing based on the commercial automatic car washing.

VIII.   REFERENCES

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