

AUTOMATIC ROAD DIVIDER PAINTING MACHINE FOR SMART CITIES

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ABSTRACT

Road divider painting is one of the major works in metro cities. The painted road dividers provide safety to drivers and bring out smooth traffic flow. The main aim of the project is to design and implement automatic painting machine to achieve simplicity, faster process, accuracy in painting as the construction industry is labor intensive. The main problem in the conventional process is it includes the traffic jam, repetitive work, time-consuming and more efforts are required and also conducted in a dangerous situation, therefore, the importance of road divider painting machine has been realized. The methodology operates on microcontroller interfacing with input/ output devices, driver, and mechanical equipment. The machine mainly uses solar energy to work which makes the machine Eco-friendly and makes the work easier, safer, faster and accurate as a consequence. In addition, it would also help to reduce or eliminate human exposure to difficult and hazardous environments.

Keywords: - Microcontroller interfacing, automation, time saving, Eco-friendly

1. INTRODUCTION

Road divider may perform many functions such as divide the road and discourage drivers from parking or driving on sidewalks and lawns. Road divider paintings promote road safety and bring out the smooth guided path of travel. Road divider painting is one of the major works in smart cities. The road divider painting is hand operated and conducted in dangerous situations; therefore the importance of automatic road divider painting machine has been realized. The automation in painting started in early 90's aiming to optimize equipment operations, improve safety and save time. The conventional method of road divider painting is time and effort consuming and causes traffic congestion due to that automatic road divider painting machine is adopted because only one operator may supervise the machine and no need to carry extra equipment; in this way, it is convenient also for cheap labor markets.

The painting of road divider is done along main roads, sector roads, parking areas and metro pillars. The length of each paint band shall cover two precast stones. The painting may do with Roadex paint in black and yellow or black and white. Before painting, the surfaces should be free from dust, dirt, mildew, fungus, loose materials, faults, defects and otherwise properly prepare the surface to receive paint. The road dividers are of different shapes and sizes. The height of road divider varies from 1ft - 3ft. The painting distance for each color is 1ft. and each coating should be providing two times for perfect finish.

1.1 Project background

The machine is designed to reduce the time required for painting, to avoid traffic congestion and to achieve accuracy in painting. This machine is compact and losses are less because of less number of moving parts. Due to elegant and simple construction it can control noise and vibration and does a silent operation and no vibration is produced.

1.2 Objective of project

The main objective to design and implement this project is as follows:

- 1) To achieve accuracy in painting.
- 2) To use optimum manpower.
- 3) To make the whole process Eco-friendly.
- 4) To avoid traffic congestion.

2. BLOCK DIAGRAM AND DESCRIPTION

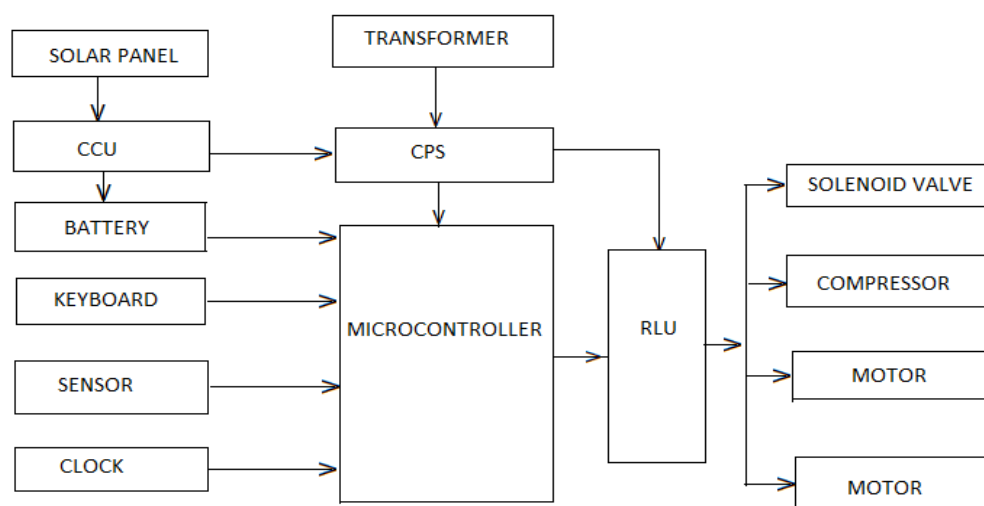


Figure 1 .Block Diagram

2.1 Description of block diagram:-

The block diagram of automatic road divider painting machine for smart cities is shown in fig. above. This scheme consists of a variety of parts such as solar panel, control circuit unit, keyboard, sensor, control power supply, transformer, microcontroller, RLU, solenoid valve, compressor and motors.

2.1.1 Solar panel

The Solar panels or photovoltaic cells are used for the conversion of solar energy into electric energy using photovoltaic effect. The solar panels are inflexible modules made of silicon or wafer-based-crystalline silicon. Several photovoltaic cells are interconnected to form a module and an array of these modules is called as a solar panel. The complete project works on the electricity produced using solar panel. The solar energy collected by panels is stored in batteries.

2.1.2 Battery

The Battery is used in the project in order to provide supply to the controller unit. The lead-acid battery uses constant-current constant voltage charge method. A regulated current raises the terminal voltage until the upper charge voltage limit is reached at which point current drops due to saturation. The charge time is 8 -10 hours. The battery is a rechargeable battery. The Battery is having a very low energy-to-weight ratio and a low energy-to-volume ratio, cells maintain a relatively large power-to-weight ratio as battery supplies very high surge current.

These features, along with their low cost, make them attractive for use in motor vehicles to provide the high current required by automobile starter motors.

2.1.3 Transformer

A Transformer is a static device which transfers electrical energy from one circuit to another with changes in voltage and current and no change in frequency. The transformer works on a principle of electromagnetic induction. The transformer used in a project is 12-0-12 V step down with center tapping for getting 12 V and 24 V simultaneously

2.1.4 Control power supply

In control power supply using full wave rectification the dc level obtained from sinusoidal input can be improved. The circuit is in the bridge manner which used two diodes. From the basic configuration, we see that one diode is conducting during period $t=0$ to $T/2$ while another diode is "OFF" during this period. Similarly, during a negative half cycle, the second diode will conduct. The capacitor is connected to rectifier output which works as a capacitor filter circuit. The regulated power supply provides short circuit protection in addition to maintain load regulation and line regulation. It involves PCB design.

2.1.5 Microcontroller

The microcontroller used is 89C51 with 4Kbytes of flash Programmable and Erasable Read-only Memory (PEROM). The Microcontroller is the brain of the system. The 89C51 is a low power, 8-bit high-frequency CMOS. The device is compatible with the MCS-51 instruction set and pin-out and manufactured using Atmel's high-density nonvolatile memory technology.

In 40 pin 89C51, there are 32 pins for parallel ports. One pin includes 8 pins, so 32 pins formed 4 parallel ports; each of them is designated as P_1 , P_2 , P_3 , and P_0 . The Number of each pin of parallel port starts from 0 through 7, the first pin of a port is named as $P0.0$ and the last pin of port 3 is named as $P3.7$ and works on a 5V supply. Pin configuration diagram of 89C51 can be seen in the figure.

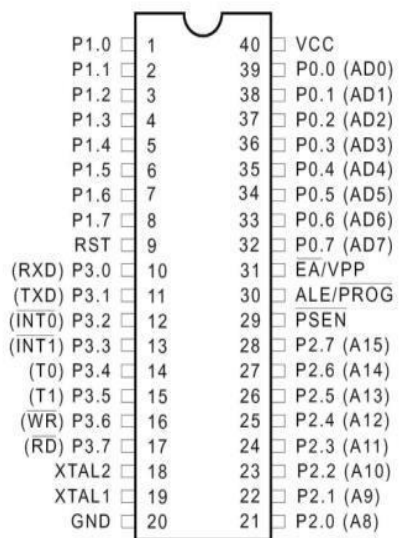


Figure 2. Pin Configuration of 89C51 Microcontroller

2.1.6 Solenoid valve

A Solenoid valve is an electromechanically operated valve. The valve is made of an electric coil and at centre, a plunger is placed. The plunger is a movable ferromagnetic core. When electric current flows through the coil magnetic field gets created. A force gets exerted on the plunger due to the magnetic field. The solenoid valve is used to ON or OFF. It is used to control the flow of paint.

2.1.7 Compressor

A compressor is a device that converts power into potential energy stored in pressurized air (i.e., compressed air). In order to increase the pressure more and more air is stored in the storage tank. Air compressor used is of 300 PSI, 12V dc rating.

2.1.8 DC Motor

DC Motor converts electric energy into mechanical energy. A DC Motor uses direct current –in other words, the direction of current flows in one direction. DC motor is used because of ease of controlling speed and direction. They are capable of the infinite speed range, from full speed to zero, with a wide range of loads. Because DC Motors has a high torque to inertia ratio, they can respond quickly to changes in control signals A DC Motor can be smoothly controlled to zero motion and instantly accelerated in the opposite direction without the need for complex power –switching circuitry. These motors are inexpensive, lightweight and reasonably efficient.

3. WORKING PRINCIPLE

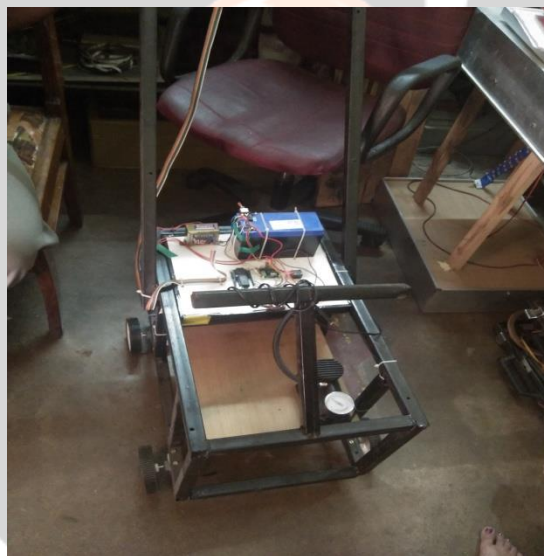


Figure 3. Actual system

All equipment such as DC Motor, Solar Panel, Battery, Solenoid valve, Compressor, and Control board which is used to control the working of the whole system is placed on the frame stand. The frame stand is steel welded in such a way that it can carry whole equipment. The steels are welded strongly in the welding workshop. In order to move the machine in a specific direction, four wheels are attached to the stand, out of which two wheels work as freewheels. So that the movement of front and back wheels are controlled. The movement of these wheels is controlled by dc motor rotation which is controlled by a microcontroller. Such that movement of the entire machine is control.

The power supply used is through battery which is charged through solar panel and supply from a transformer is used as a backup supply in case of sunlight is not available. The 12 V supply is given to the control power supply unit where it gets converted to 5v which is suitable for the microcontroller. Using program the distance is set to 1 ft. so that when supply is given to microcontroller relay will operate and painting starts as per requirement. The relay used in the project is Double Pole Double Through relay. The relay is used for indication and control purpose. The DC Motor not only used for movement of the system but also used for the dust removal.

The machine mainly works on microcontroller interfacing with equipment, motor, driver, and solenoid valve. The two ICs used are L7805 (1A, 5V) and L7812 (1A, 12V). It provides thermal overload protection and no external components are required. Microcontroller drives the solenoid valve which is used to ON and OFF the machine. The compressor is used to provide pressurized air so that paint will get apply uniformly.

3.2 Flow Chart

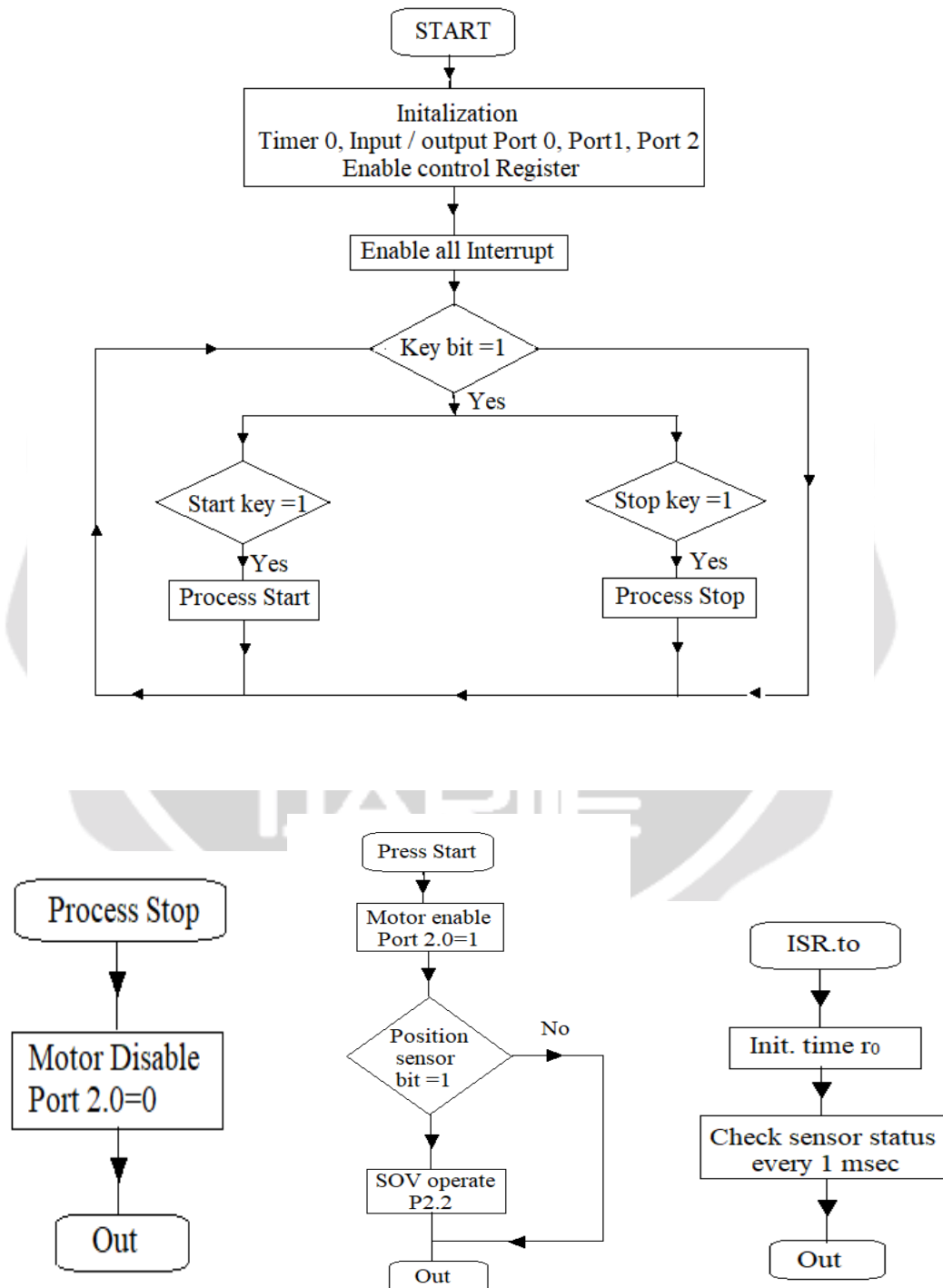


Figure 4. Flow chart of system

4. CONCLUSIONS

The automatic painting machine for road dividers is design and implemented successfully. The machine paints the divider in minimum time, with less efforts and minimum cost. The problem of traffic congestion is eliminated.

5. ACNOLEGMENT

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