**Project Name:** Automatic car parking system using CCTV footage.

**Objectives:**

1. Stopping the usage of "**IR Sensor**" to automate parking garages is a particular aim of this initiative. In our project, no **IR sensors** are utilized.
2. The goal of this project is to use image processing to create an intelligent parking system.

**Project Component:**

**CCTV:** CCTV (closed-circuit television) is a TV system in which signals are not publicly distributed but are monitored, primarily for surveillance and security purposes.

Closed-circuit television, also known as video surveillance, is the use of video cameras to transmit a signal to a specific place, on a limited set of monitors. This system allows the use of videos cameras to monitor the interior and exterior of a property, transmitting the signal to a monitor or set of monitors.

We use mobile phone camera as a CCTV camera by USB cable. It observes the parking slots frame by frame. The entering and exit points of the parking spot is also observed. The parking slots are defined by programming

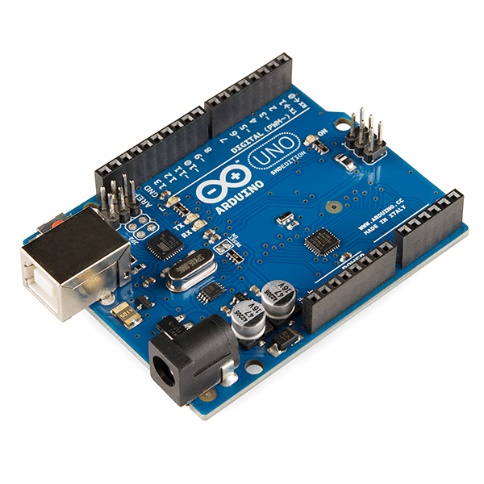
**Microcontroller:** the Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button.

Memory: SRAM

Storage: Flash, EEPROM

Developer: Arduino

CPU: microchip AVR (8-bit)



**RGB LED:** An RGB LED is basically an LED package that can produce almost any color. RGB (red, green, and blue) refers to a system for representing the colors to be used. There are two kinds of RGB LEDs: common cathode and common anode RGB LEDs. The common cathode has all the cathode of the LED connected together.

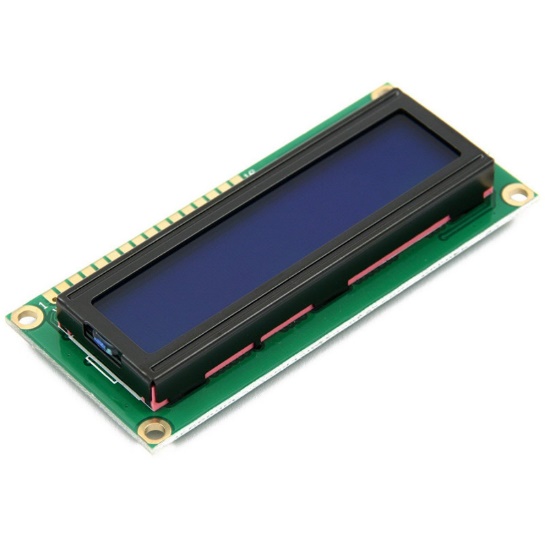
We use common cathode RGB LED. The blue light will active when any car trace place at exit point. If any car take place at the enter point but there is no slot available, the red light will active. If there any slot is available, green light will active.



**Diffuser:** An LED diffuser sheet is, typically, a component in screen backlights. Its main purpose is to evenly distribute light from LEDs on the edge of the screen, so that there are no bright spots near them. It is usually composed of many sheets of plastic in varying thicknesses and opacity or reflectivity.

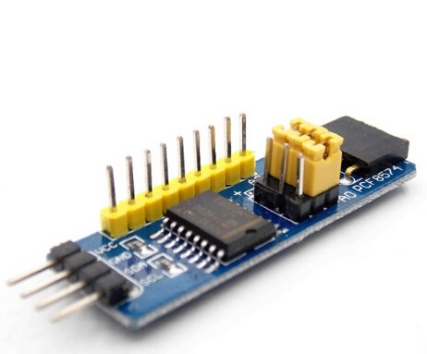
**LCD display:** A liquid-crystal display (LCD) is a [flat-panel display](https://en.wikipedia.org/wiki/Flat_panel_display) or other [electronically modulated optical device](https://en.wikipedia.org/wiki/Electro-optic_modulator) that uses the light-modulating properties of [liquid crystals](https://en.wikipedia.org/wiki/Liquid_crystal) combined with [polarizers](https://en.wikipedia.org/wiki/Polarizer). Liquid crystals do not emit light directly, instead using a [backlight](https://en.wikipedia.org/wiki/Backlight) or [reflector](https://en.wikipedia.org/wiki/Reflector_(photography)) to produce images in color or [monochrome](https://en.wikipedia.org/wiki/Monochrome_monitor).LCD1602, or 1602 character-type liquid crystal display, is a kind of dot matrix module to show letters, numbers, and characters and so on. It's composed of 5x7 or 5x11 dot matrix positions, each position can display one character.

We use LCD Display 16x2 which model is LCD1602. Number of available slots are displayed in the LCD. If there is no slot available, it shows “no slot available”.



**I2C module:** I2C is a synchronous, multi slave, multi master packet switched, single-ended serial bus. Multiple chips can be connect to the same bus. I2C uses only two bidirectional open collector or open drain lines, Serial Data Line (SDA) and Serial Clock Line (SCL), pulled up with resistors.The PCF8574 module can be used to expand the digital I/O of an MCU using the I2C bus. The modules can be daisy-chained to increase I/O up to 64.

We use I2C module which model is PCF9574.



**Servo motor:** Micro Servo Motor SG90 is a tiny and lightweight server motor with high output power. Servo can rotate approximately 0 to180 degrees (90 in each direction), and works just like the standard kinds but smaller.

We use it as a door and the door is controlled by programming. When the door is open its position is at 0 degree and when it close the door it position is 100 degree. If there is any slot available, when a new car wants to enter the servo motor rotate 100 degree to zero degree opens the door and after entering the car the motor automatically close. And when there is no available slot, the door will remain closed. If any car take place at the exit point the door automatically open.



**Buzzer:** A buzzer or beeper is an [audio](https://en.wikipedia.org/wiki/Sound) signaling device. Which may be mechanical, electromechanical or [piezoelectric](https://en.wikipedia.org/wiki/Piezoelectricity) (piezo for short). Typical uses of buzzers and beepers include [alarm devices](https://en.wikipedia.org/wiki/Alarm_devices), [timers](https://en.wikipedia.org/wiki/Timer), [train](https://en.wikipedia.org/wiki/Train) and confirmation of user input such as a mouse click or keystroke.

We use a buzzer to make an audio signal when a car take place at the enter point but there is no slots are available.



**PCB:** A printed circuit board (PCB) is the board base for physically supporting and wiring the surface-mounted and socketed components in most electronics.

It is used to mechanically support and electrically connect electronic components using conductive pathways, tracks or signal traces etched from copper sheets laminated onto a non-conductive substrate. We use it to connect the devices.

**Required Components**

1. **CCTV**
2. **Microcontroller(Arduino Uno)**
3. **RGB LED (Common Cathod)**
4. **Diffuser**
5. **LCD display( LCD1602)**
6. **I2C Module (PCF8574)**
7. **Servo Motor (SG90)**
8. **Jumper Wire**
9. **Buzzer**
10. **PCB**

|  |  |  |
| --- | --- | --- |
| Name | Model | Price (tk) |
| CCTV | Use mobile phone camera |  |
| Microcontroller  (Arduino Uno) |  | 738 |
| RGB (Common Cathod) |  | 15 |
| LCD Display16x2 | LCD1602 | 310 |
| I2C Module | PCF8574 |
| Servo Motor | SG90 | 200 |
| Jumper Wires  (male to male, male to female , female to female) |  | 30 |
| Buzzer |  | 12 |
| Diffuser |  |  |
| PCB |  | 60 |
| Foam Board |  | 40 |
| String |  | 5 |
| Glue |  | 20 |
| Toy Cars |  | 170 |

Total=

**Block diagram:-**

Image

Acquisition

and Processing

Data

Interpretation

System

Initialization

Display

Update

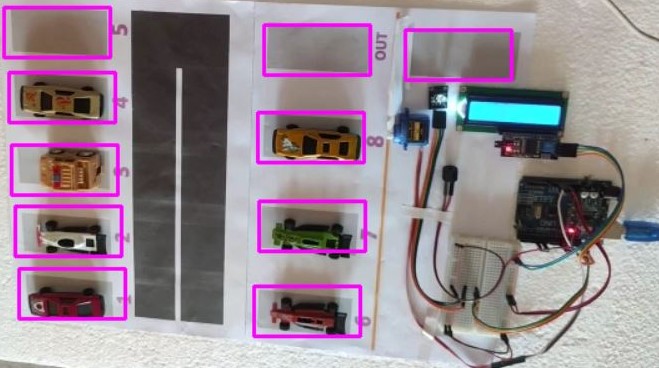
**Figure1:-Block diagram of car parking system**

**Methodology**

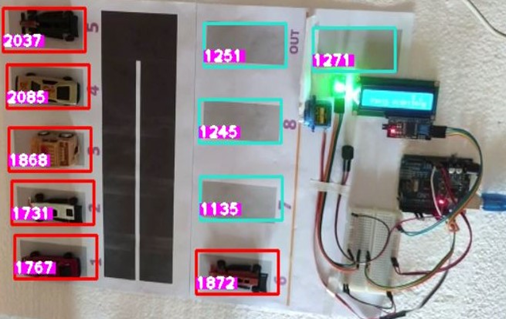
**System Operation**

The operation of the system involves four major sub-operations. These modules are system initialization, image acquisition and processing, data interpretation, and display update. The last three processes are then repeated as long as the system is active. The initialization of the parking guidance system takes place once, when the system is being set up for the first time or after a replacement of any of the systems module. During initialization, a refresh signal is sent from the node’s controller to the image sensors in order to activate the process. Then image acquisition and processing takes place and starts working. Image processing can be discussed step by step:

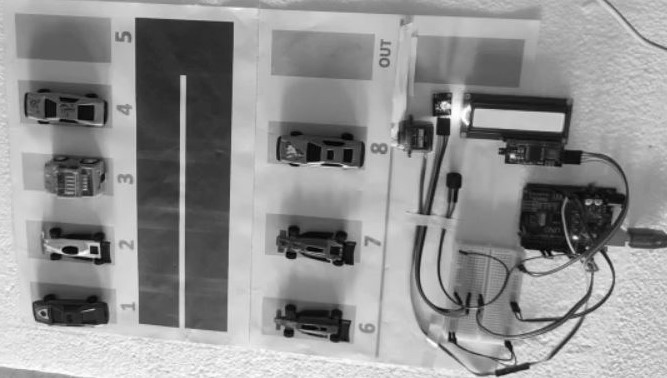
1. First of all we need to define all parking slots, entry & exist slots by detecting all of its height and weight.



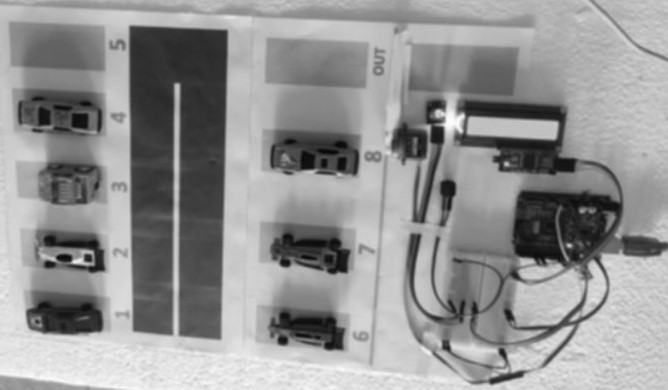
1. CCTV detects the slots pixel and then give a footage that is in BGR format. The empty slot’s pixel and the pixel of the slots with cars are different. By image processing this difference is detected and the system working.



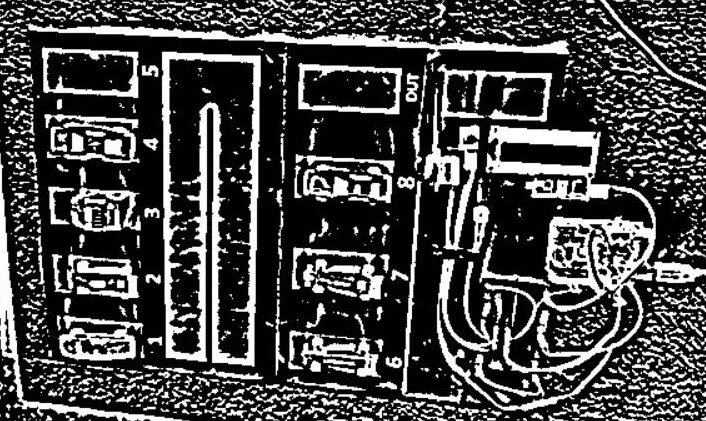
1. This BGR format is then converted into Gray scale image.

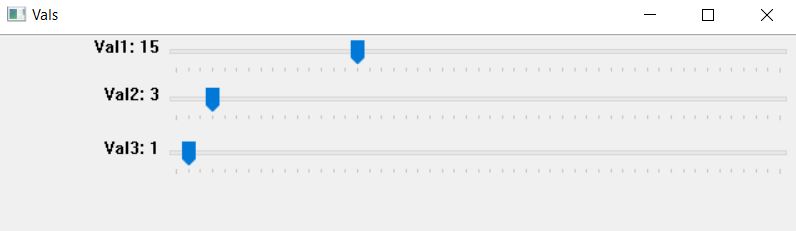


1. The Gray scale image is then converted into GaussianBlur format. This process is done with convolution theory and a 3\*3 matrix is used here which all element’s value is 1.

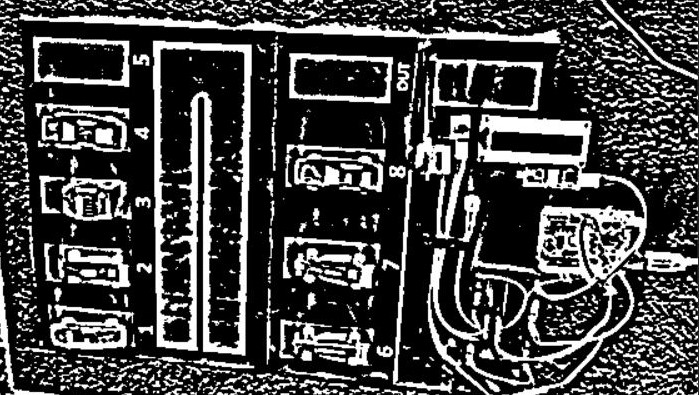


1. The image that is received from GaussianBlur is then transformed into Threshold image. Here Threshold value 15 & 3 are used by using trackbar. Adaptive Threshold Gaussian method is used for taking this Threshold image.

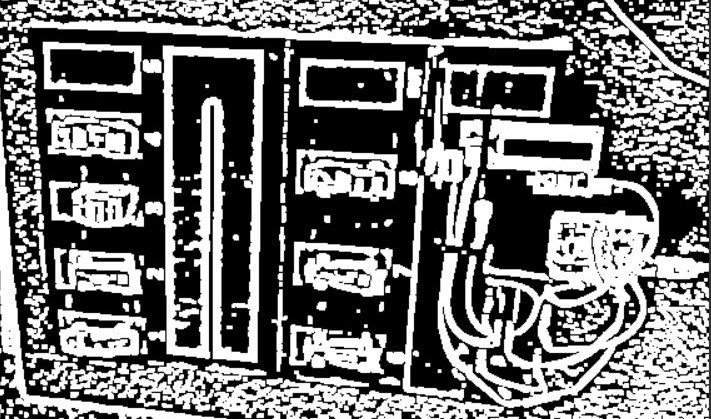




1. Threshold image is then converted into Median image.



1. The Median image is then dialted and for this purpose the Kernel Matrix (3\*3) (with all elements are 1 ) is used.



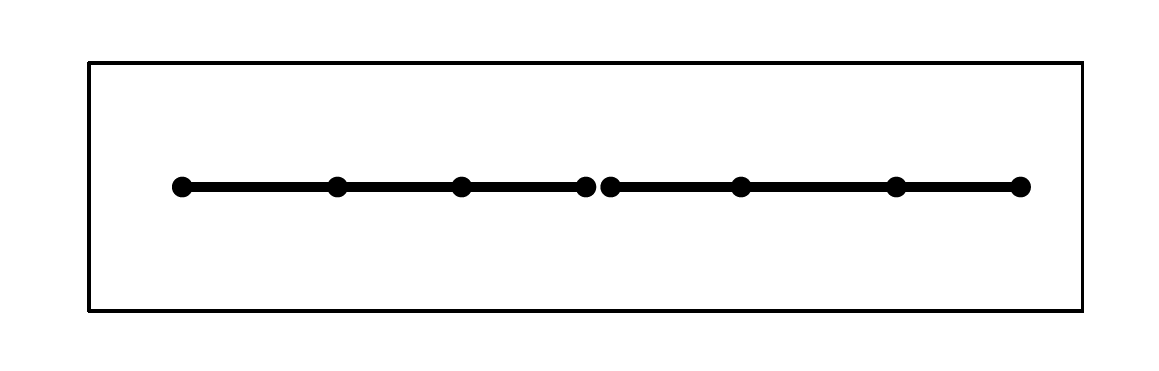
The pixel of image is counted from this dialted image.

**Description:**

1. Every parking place must now have a **CCTV** in the current day. This **CCTV** footage served as the basis for our project, which employed the "**Image Processing**" method. We will identify vacant parking spaces and spaces that are not empty using **CCTV** footage analysis. Depending on the outcome, it will let a car to enter a parking spot. The driver of a car may check the number of available slots via an LCD display that has been installed at the parking space's entrance before entering.
2. When every parking space is occupied by cars and a car tries to enter, the parking gate won't open and a buzzer will ring.
3. If there are any available slots, the gate will be opened and the LCD display will indicate the free slot numbers.
4. If a vehicle wishes to depart, the parking gate must be opened.
5. When there is available slots in parking space, the RGB will emit green light. If there is no slots available RGB will emit red light and if any vehicle wants to go out from parking space then RGB will emit blue light.

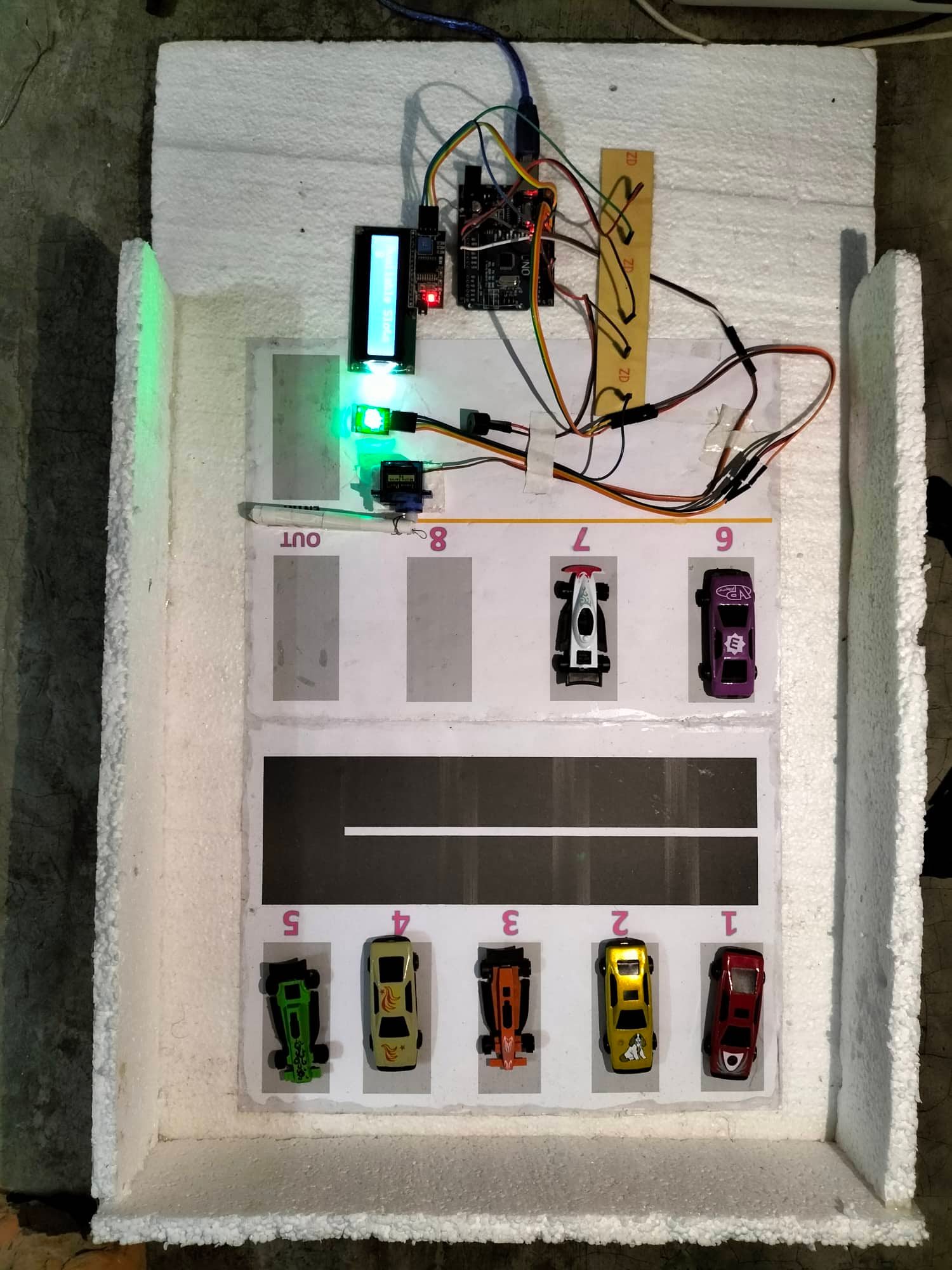
**Arduino Code**

**PCB Layout:-**

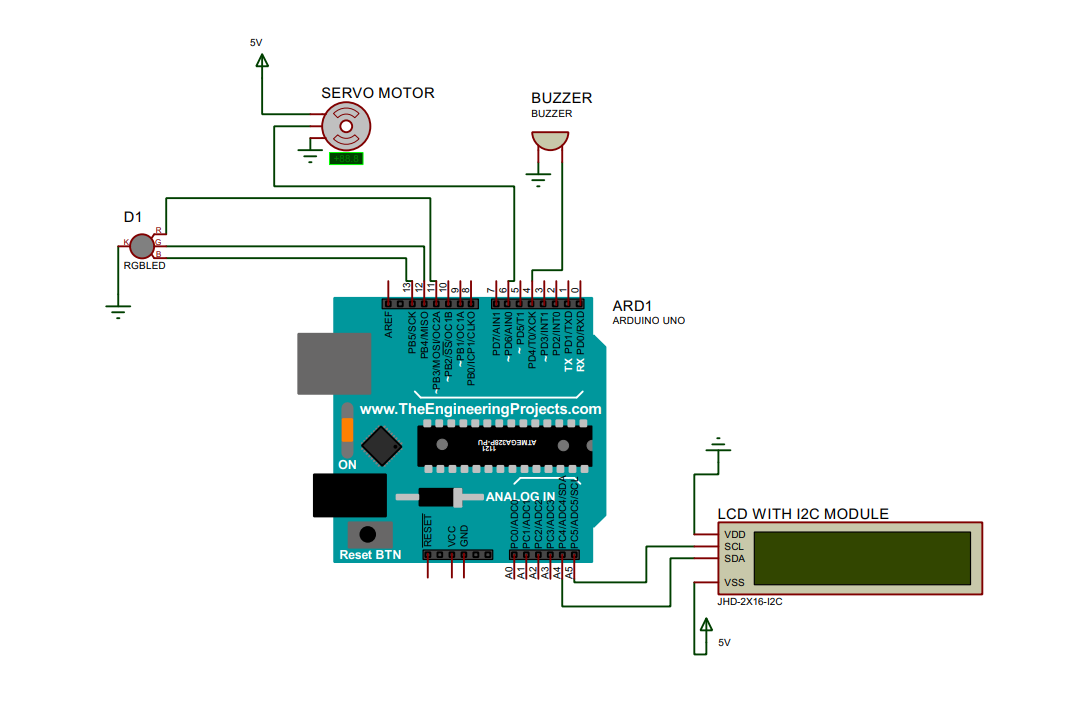
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**Figure 2:PCB layout for car parking system**

**Project picture:-**



**Figure 4:-Representation of an automatic car parking system**

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**Figure 3:Connection Diagram of Car parking system**

**Conclusion**

The image processing system accurately detected the presence of cars in parking slots. The filled image approach performed better than the use of dilated edge images to determine vacancy of parking slots. The pixel value of a vacant slot is compared with a car-parked slot and that’s how the system find out whether a slot is parked or vacant. LCD display shows the vacant slots number. If the parking slots are filled and a new car is trying to get into, then a buzzer beeps. The project met a few drawbacks. Overcoming the limitations could result it in an accomplished project. As the camera angle changes, so does the position of the parking slots. Therefore the position of slots is to be reassigned, while the project initiates. Besides CCTV footage gives more accurate pixel value than the phone camera. Adequate financial support can make it a fruitful project which will ease our problem in finding parking slots in busy areas like Residential area, office and other important places. From the outcome of project, it can easily be deduced that the proposed image processing-based car parking project is a viable option for parking space vacancy management.

**Reference:-**

* Kommey, Benjamin, Ernest O. Addo, and Andrew S. Agbemenu. "A smart image processing-based system for parking space vacancy management." *International Journal of Computer Applications* 182.5 (2018): 1-6.
* (<https://www.researchgate.net/publication/321816743_Image_processing_based_intelligent_parking_system> )