User Manual

A GUI for controlling and supervising multiple robots remotely

Version 1.0
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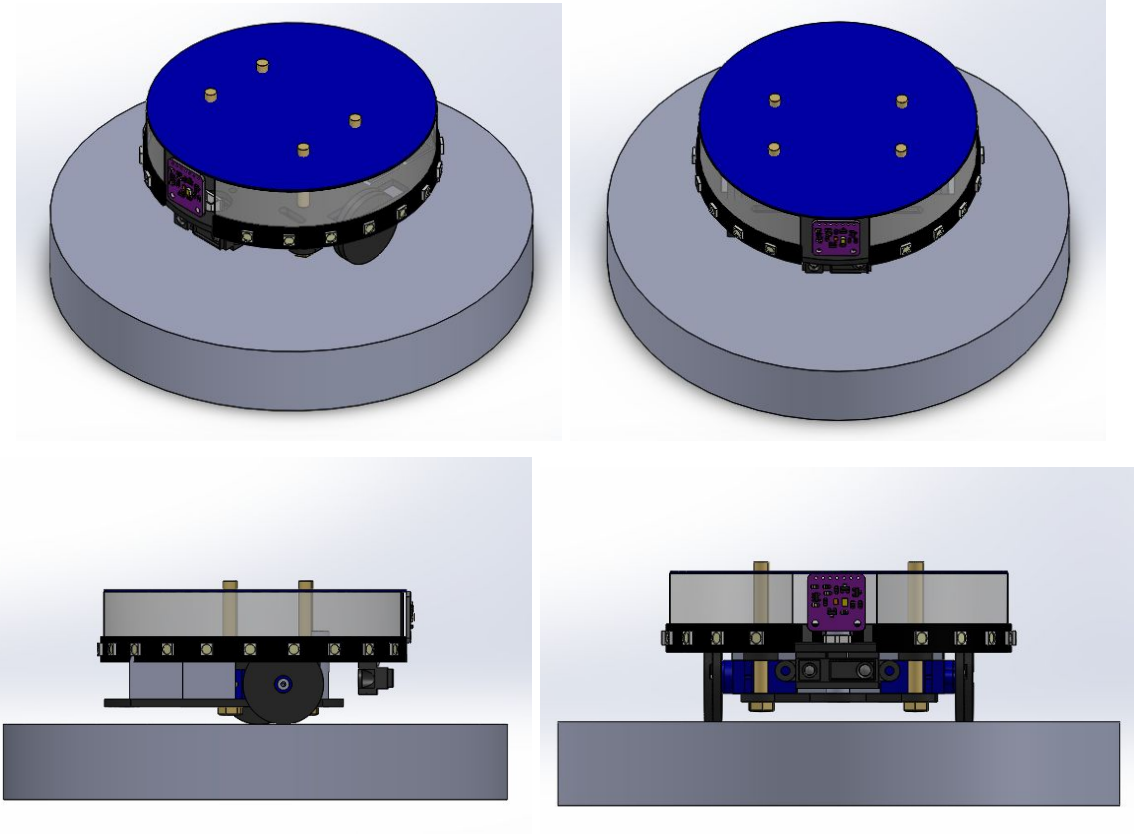
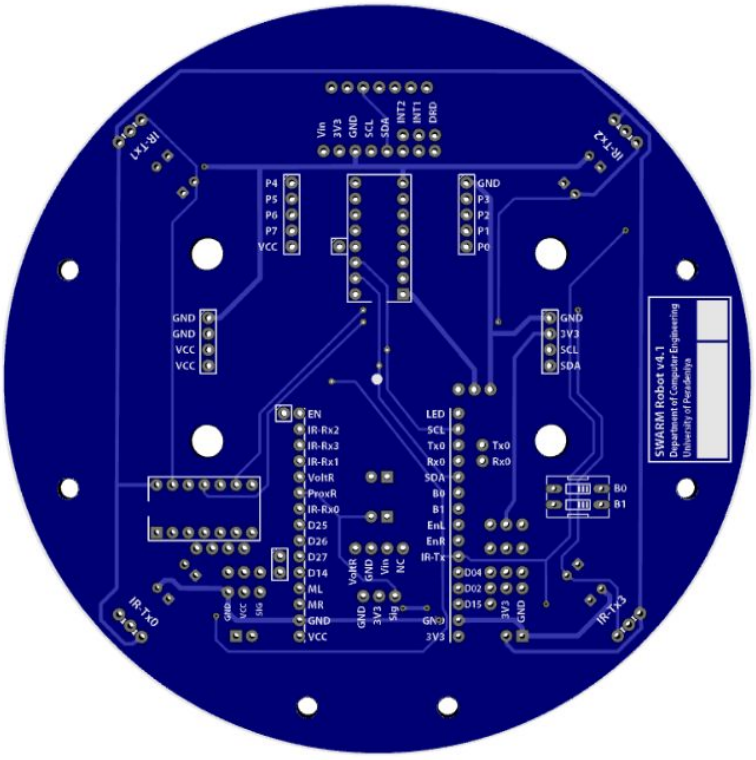
General Information

Hardware Overview

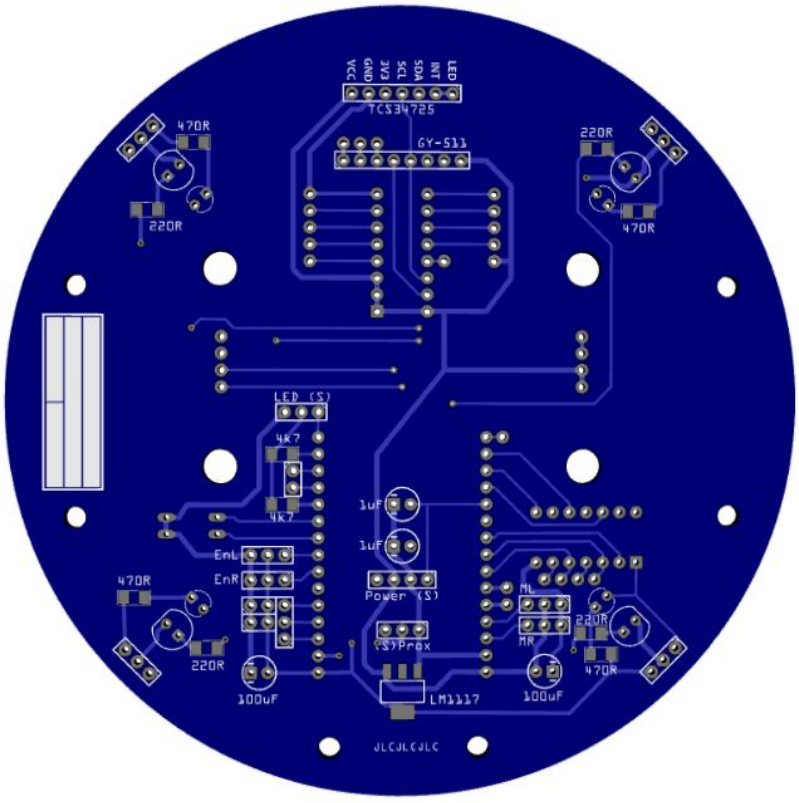
Physical Structural Design



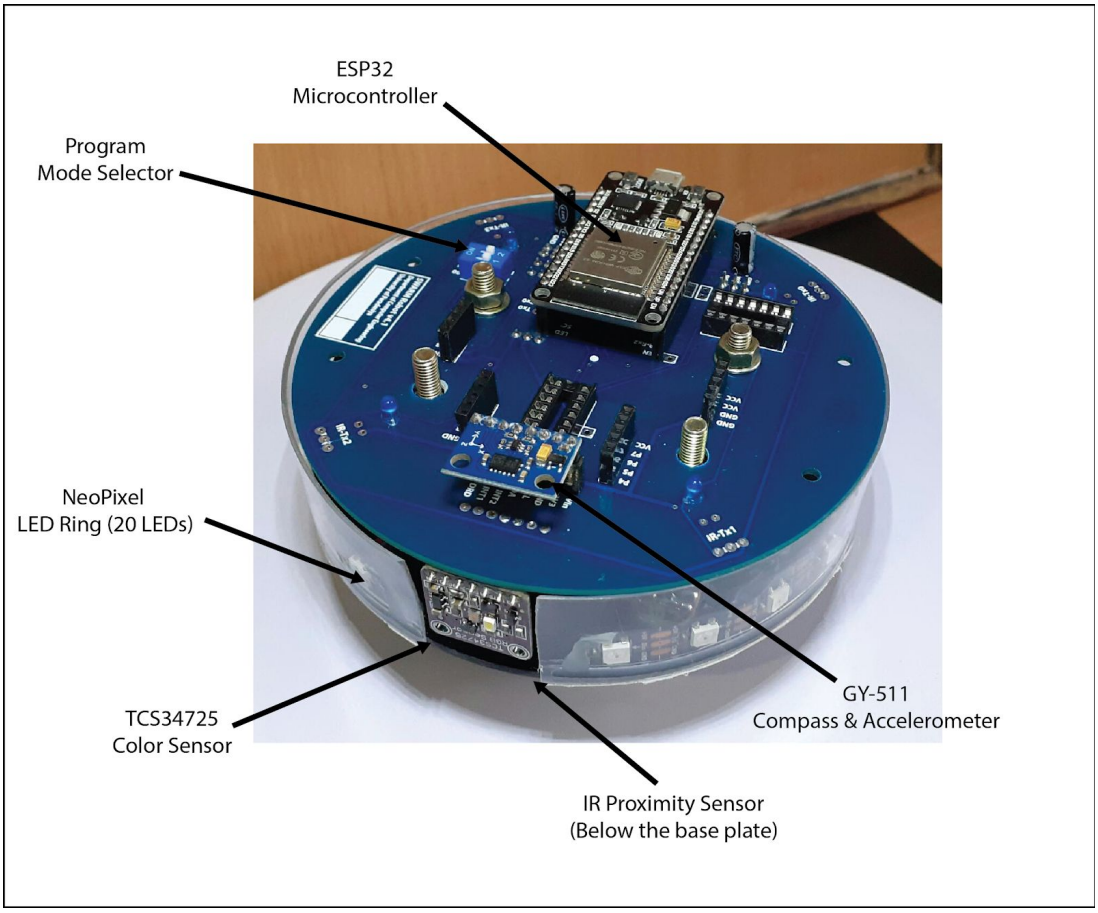
PCB Design



Top View of the PCB Layout Design



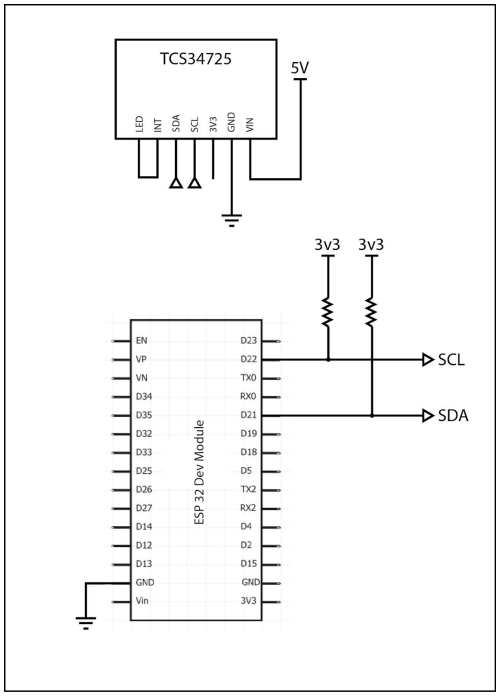
Bottom View of the PCB Layout Design



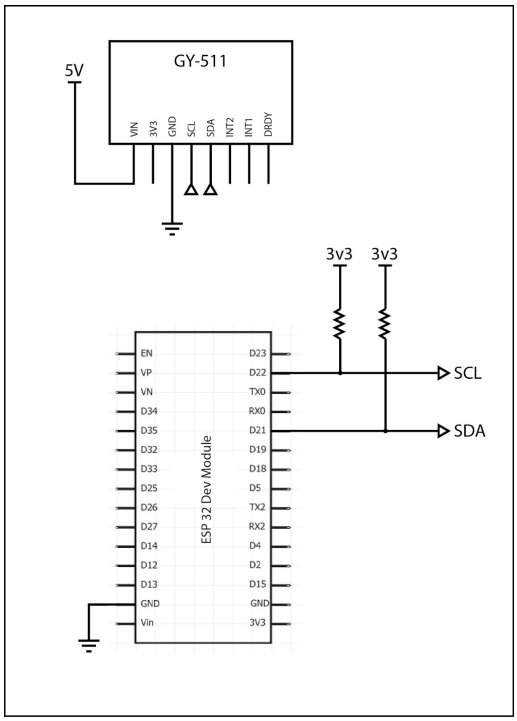
Few main component placements of the robot

Schematics Design

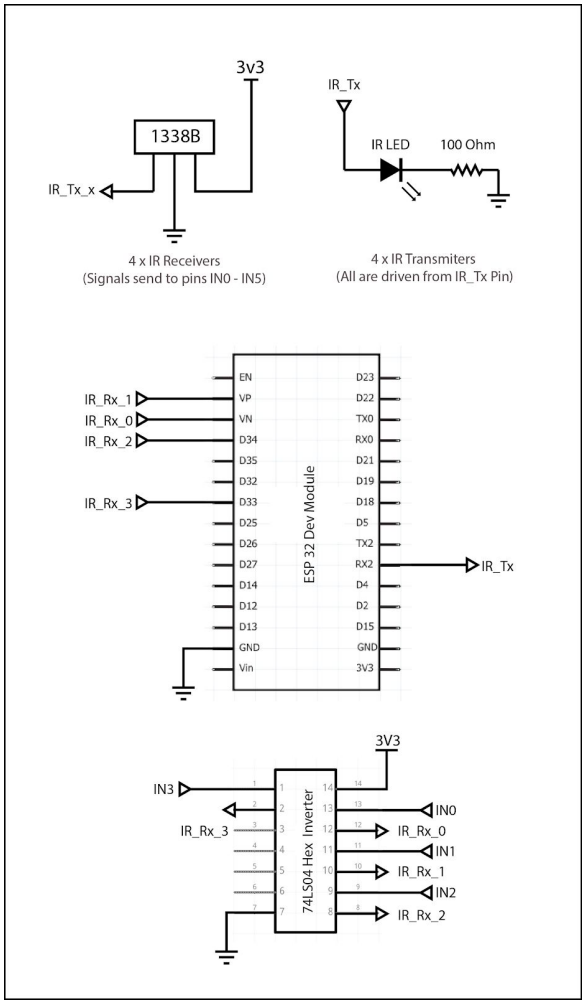
1. TCS34725 Color Sensor



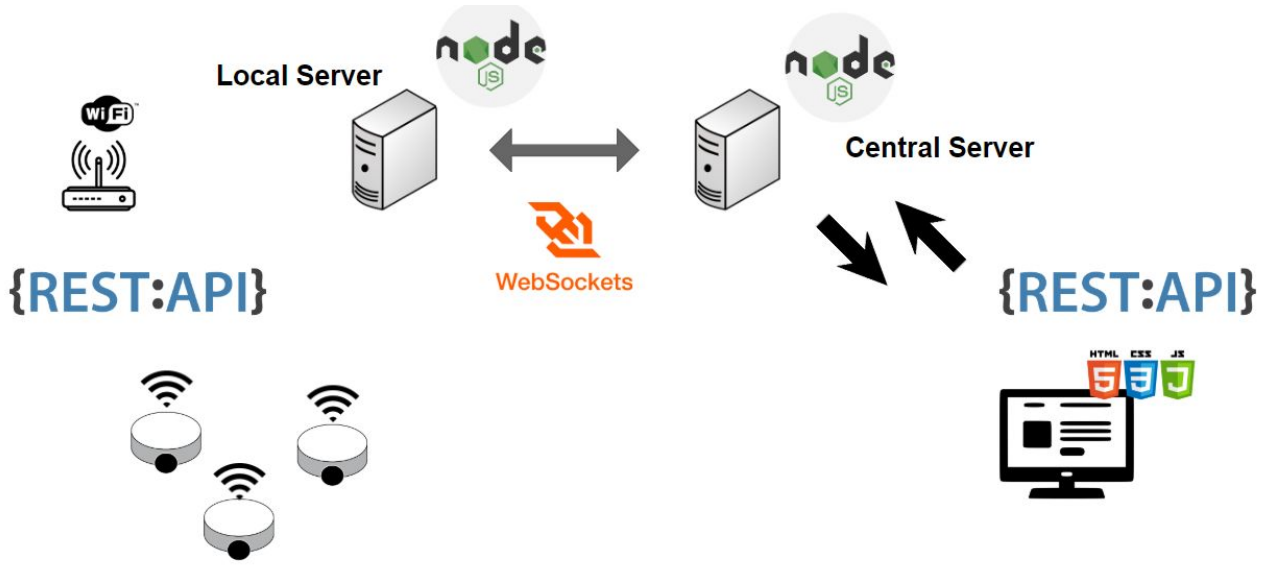
2. GY-511 6-DOF Compass and Accelerometer Sensor



3. IR Transmitter and Receiver Units



Software Overview



There are two types of servers available in communication flow. One is known as the local server, which communicates between Robot Units and the central server. This is hosted near the simulation arena and have access to hardware behaviours of the arena too (Ex: Control the environment conditions of the arena)

Other server, the central server is hosted somewhere on the internet and can be accessed by anyone using the IP address or domain of it. It can handle more than one local servers. The central server hosts the GUI (web site) and the web socket server, which communicates with local servers. Central server keeps a database, which contains configuration data and user data.

Central server and Local servers will communicate with each other using a Web Socket connection. When a local server establishing a Web socket connection with Central Server, it should provide an authentication token. The authentication token can be obtained by making HTTP Get request into central server's API gateway by providing the previous access token.

REST APIs available on the robot

Local server can identify the robots which are online on its subnet, and communicate with them using REST APIs listed below.

1. Status of the robot

   http://***{Robot IP}***/status
   Response: {“status”:“”,“version”:””,“IP”:“”}

2. Magnetometer Readings

   http://***{Robot IP}***/mag
   Response: {“x”:””,“y”:””,“z”:””,“heading”:””}

3. Accelerometer Readings

   http://***{Robot IP}***/accel
   Response: {“x”:””,“y”:””,“z”:””}

4. IR Proximity Readings

   http://***{Robot IP}***/dist
   Response: {“raw”:””,“filtered”:””}

5. Color sensor readings

   http://***{Robot IP}***/color
   Response: {“R”:””,“G”:””,“B”:””,“temp”:””,“lux”:””,}

6. Control motion of the robot

   http://***{Robot IP}***/motor?dir=**{DIR}**
   DIR = [forward, backward, rotCW, rotCCW, stop]
   Response: { “status”: ””}

7. Control the rotation of the robot

   http://***{Robot IP}***/turn?ang=**{Angle}**
   Angle = [-180, 180]
   Response: { “status”: ””}

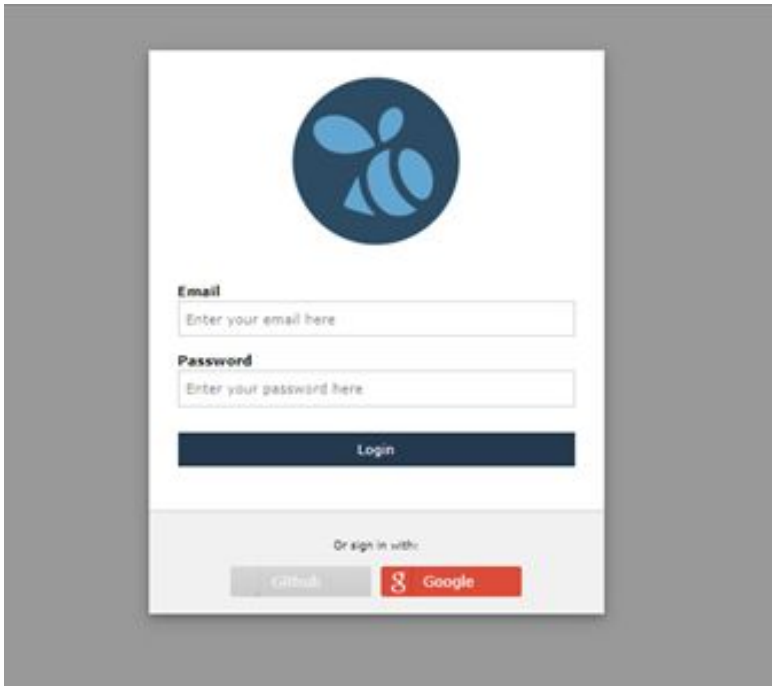
8. Control the color of the LED ring of the robot

   http://***{Robot IP}***/pixelLED/all?R=**{$1}**&G=**{$2}**&B=**{$3}**
   $1 = Red Value [0, 255]
   $2 = Green Value [0, 255]
   $3 = Blue Value [0, 255]
   Response: { “status”: ””}

User Portal

Web Interface

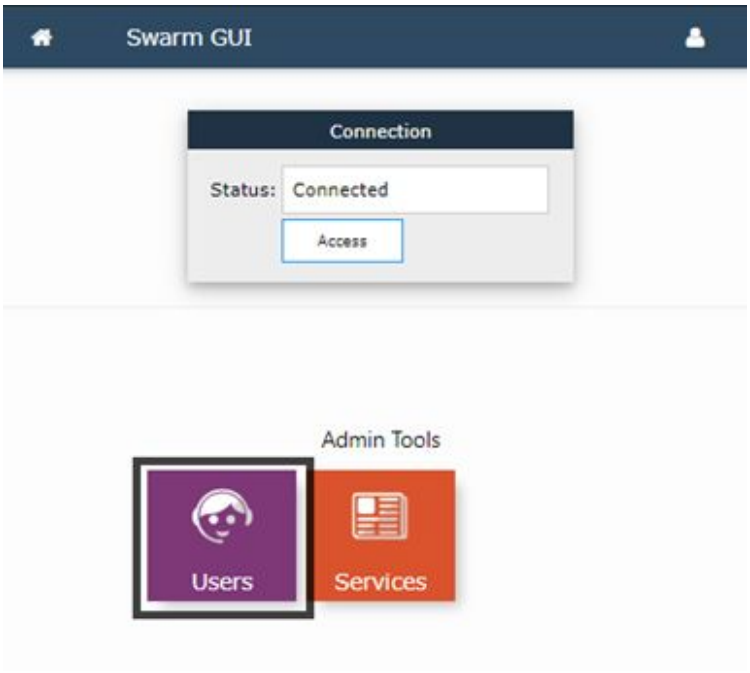
1. Login window



Users can login to the system using their email address and password. They can also use sign in with google feature for the authentication This feature simplifies the login process for users and realize a higher conversion rate for registration.

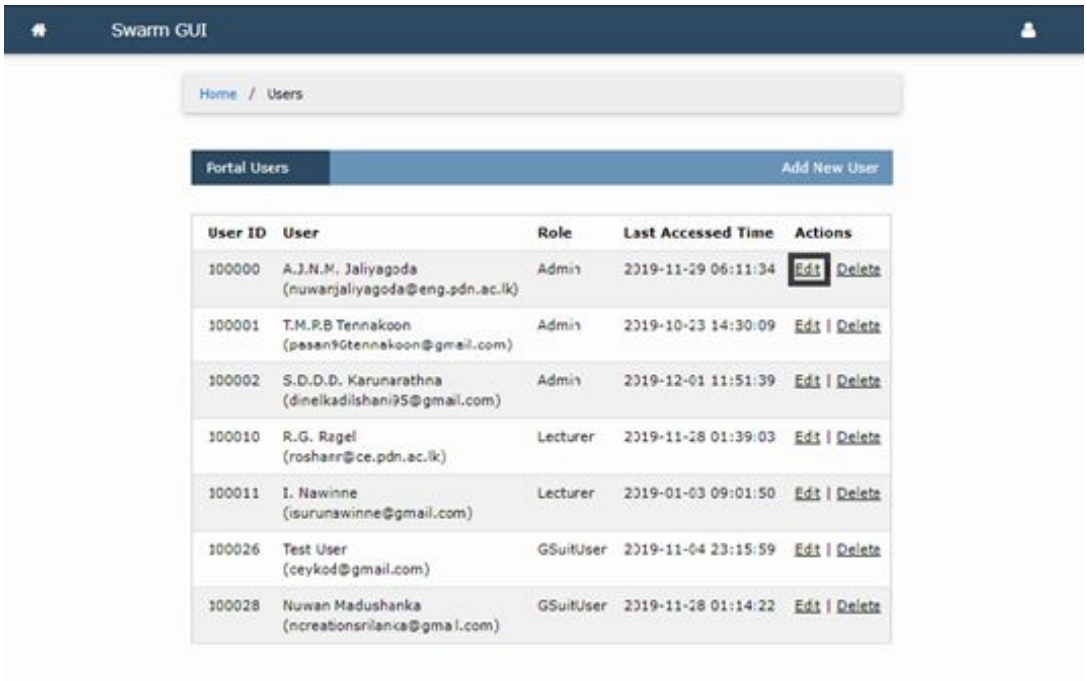
2. Landing Page

After login to the system user will be able to see the following home screen. But only an administrative person can view the section, ‘Admin Tools’.

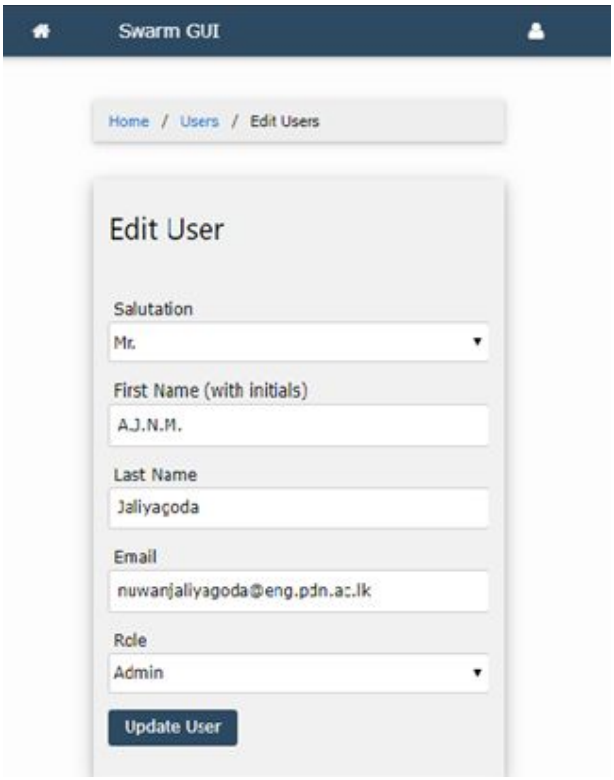


2.1 Users

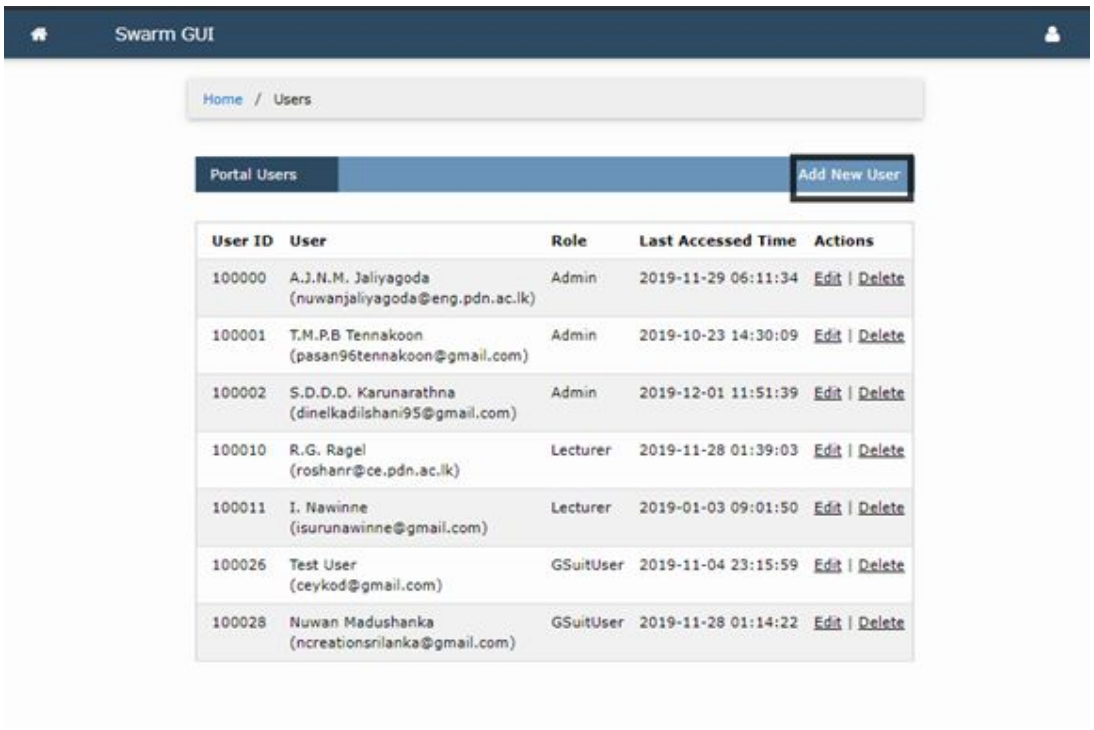
When user selects ‘**Users**’ link below screen will appear. This feature is only available for administrative users and can be used to manage users.



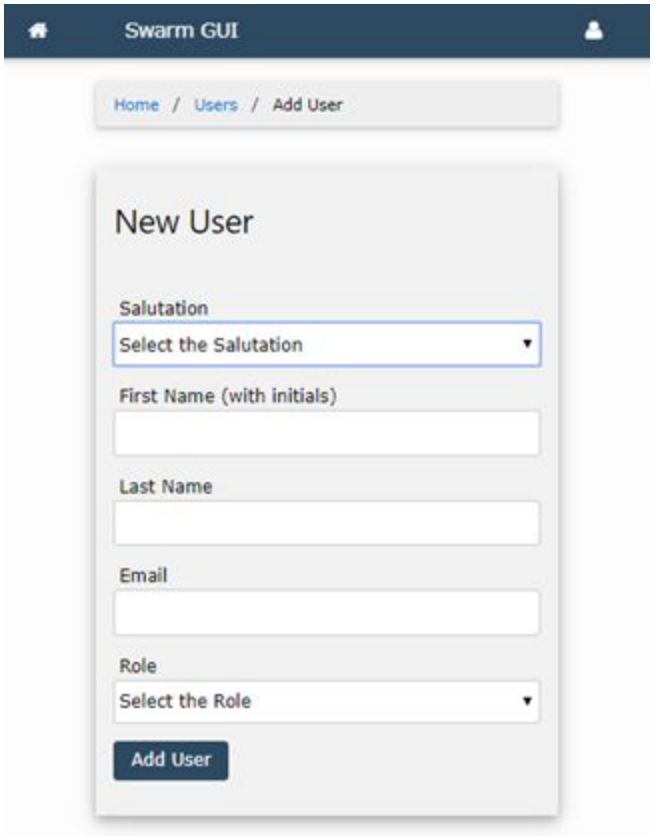
When user selects '**Edit**' link below screen will appear.



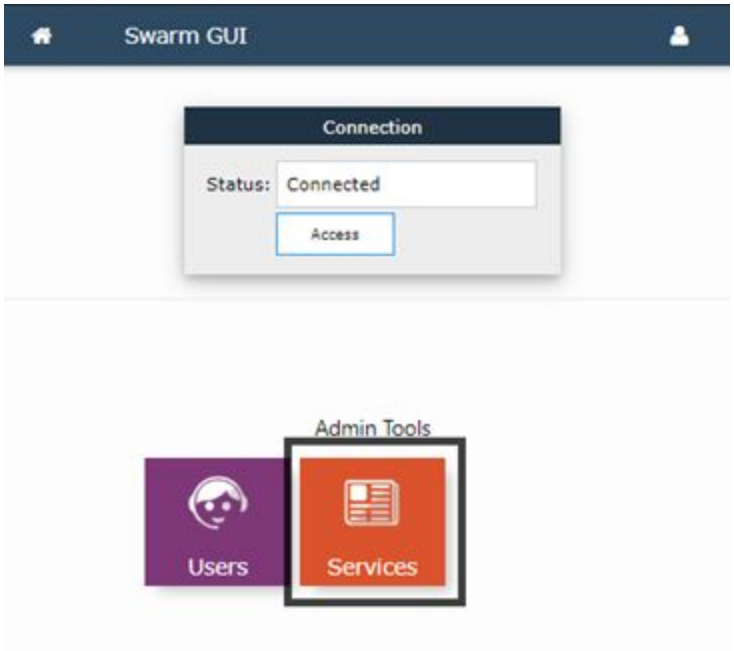
When user selects '**Add new user'** link in the Users window,



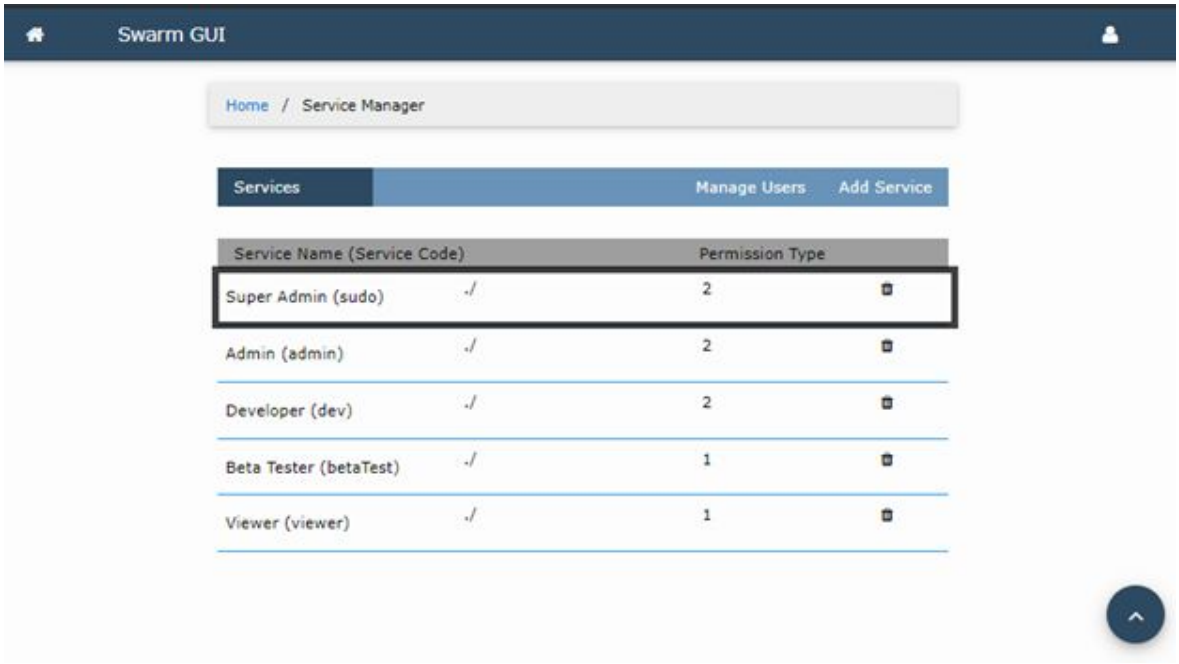
below screen will appear. So users can add new users to the system by this window



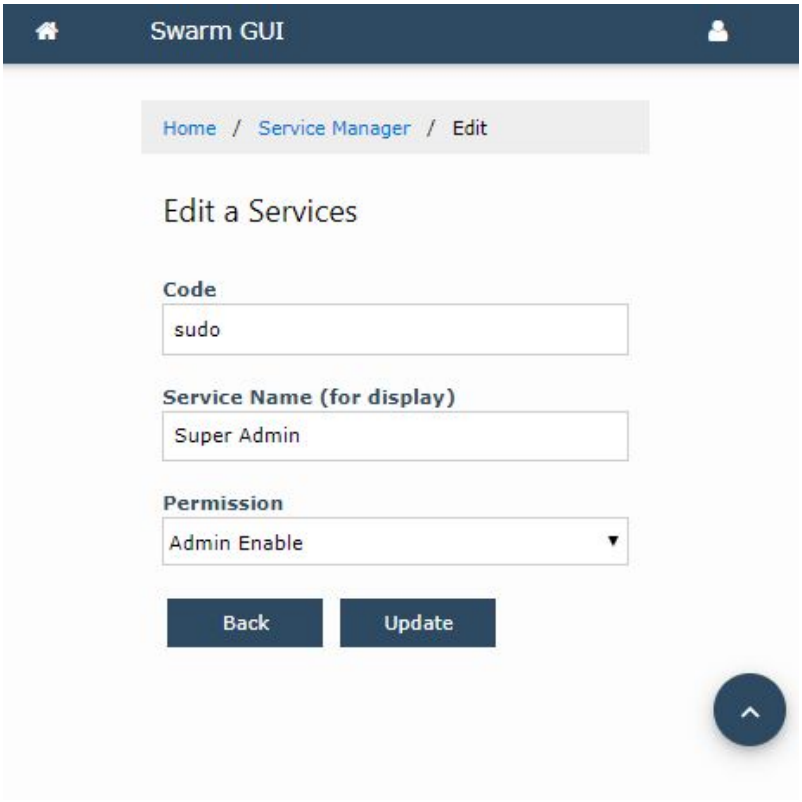
2.2 Services



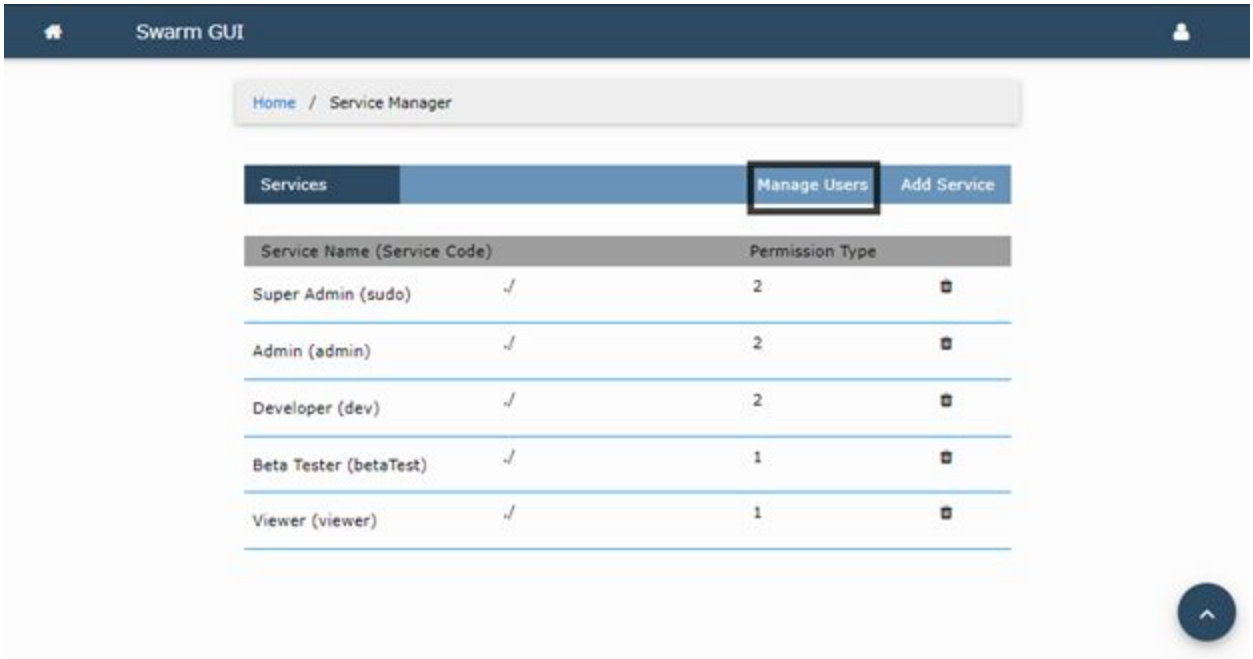
When user selects '**Services**' link in the home page below screen will appear. This control the access to the system like an Access Control List. There are few categories with different access types as below,



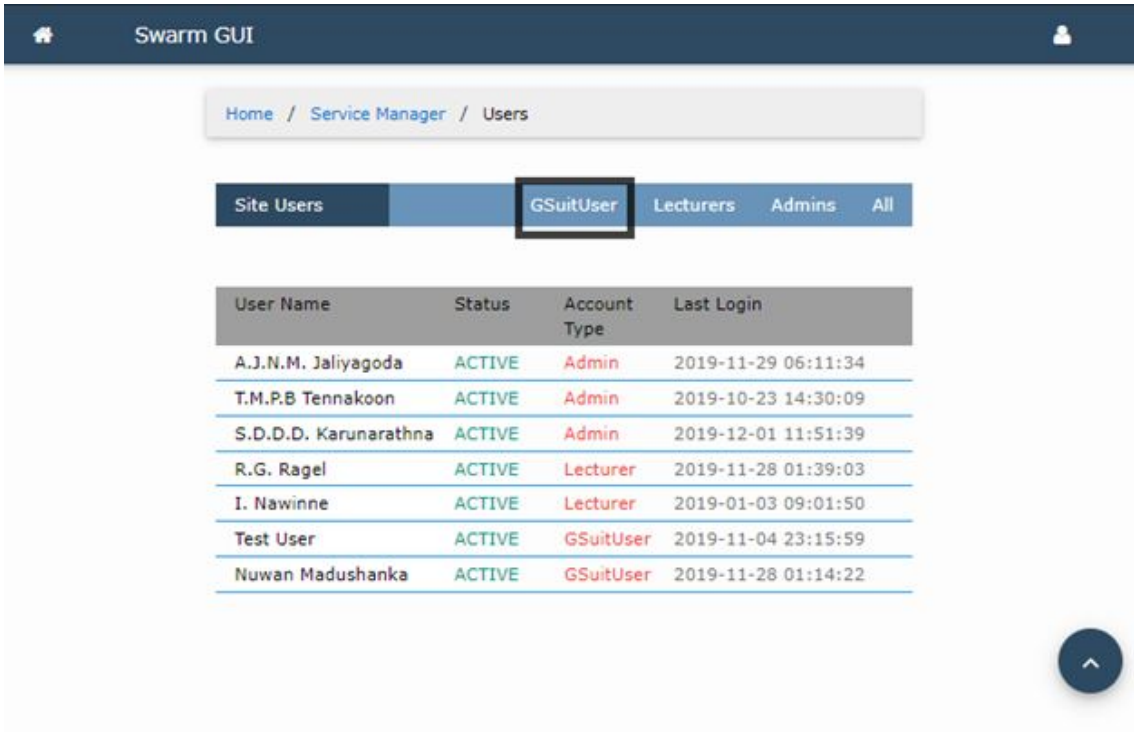
Each category can configure like this



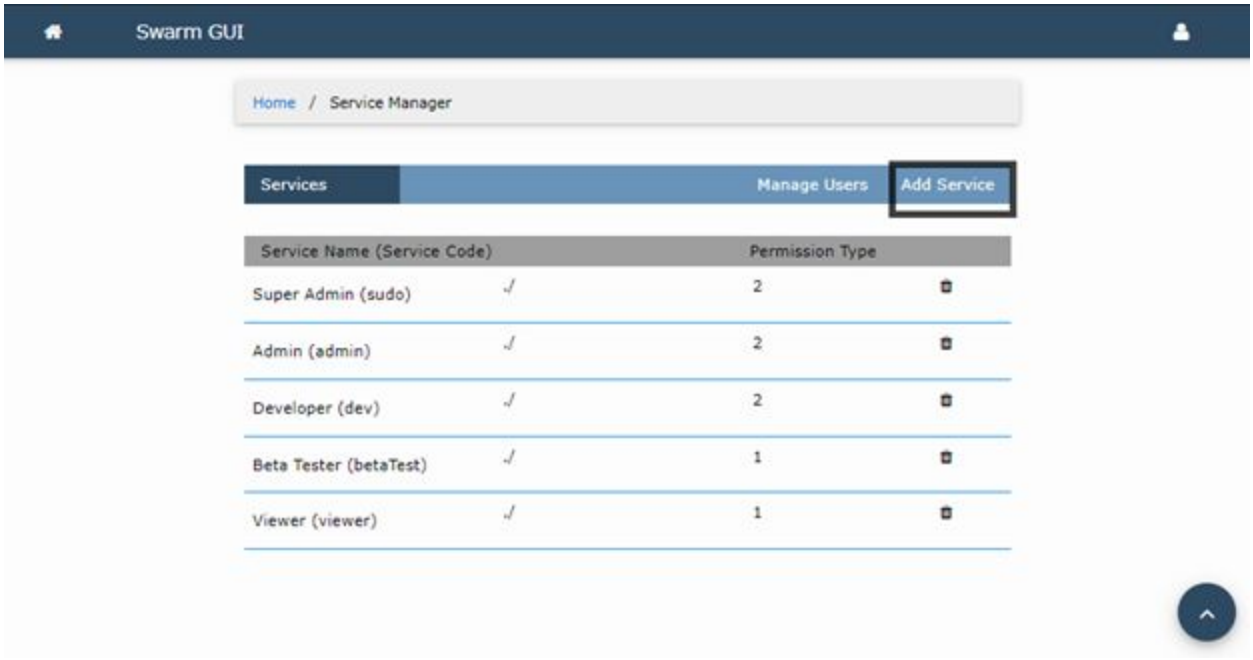
Select '**Manage Users**' can be used to view the status, account type and last login of each user.



And also it can filter the users according to the categories they belong by selecting the particular category in the right corner

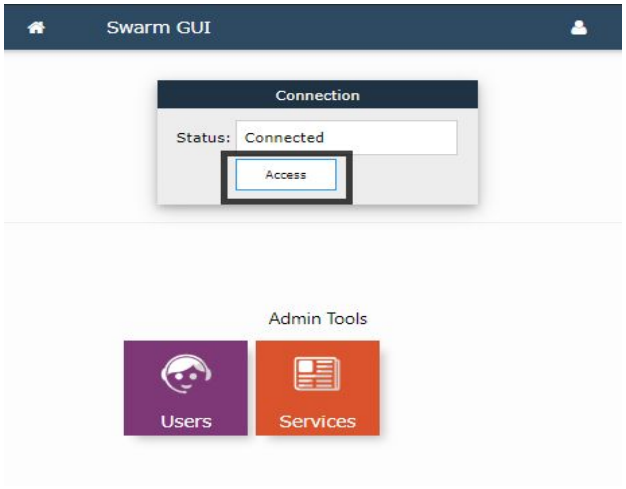


To add new services, the link '**Add services**' in Services Manager window can be used.



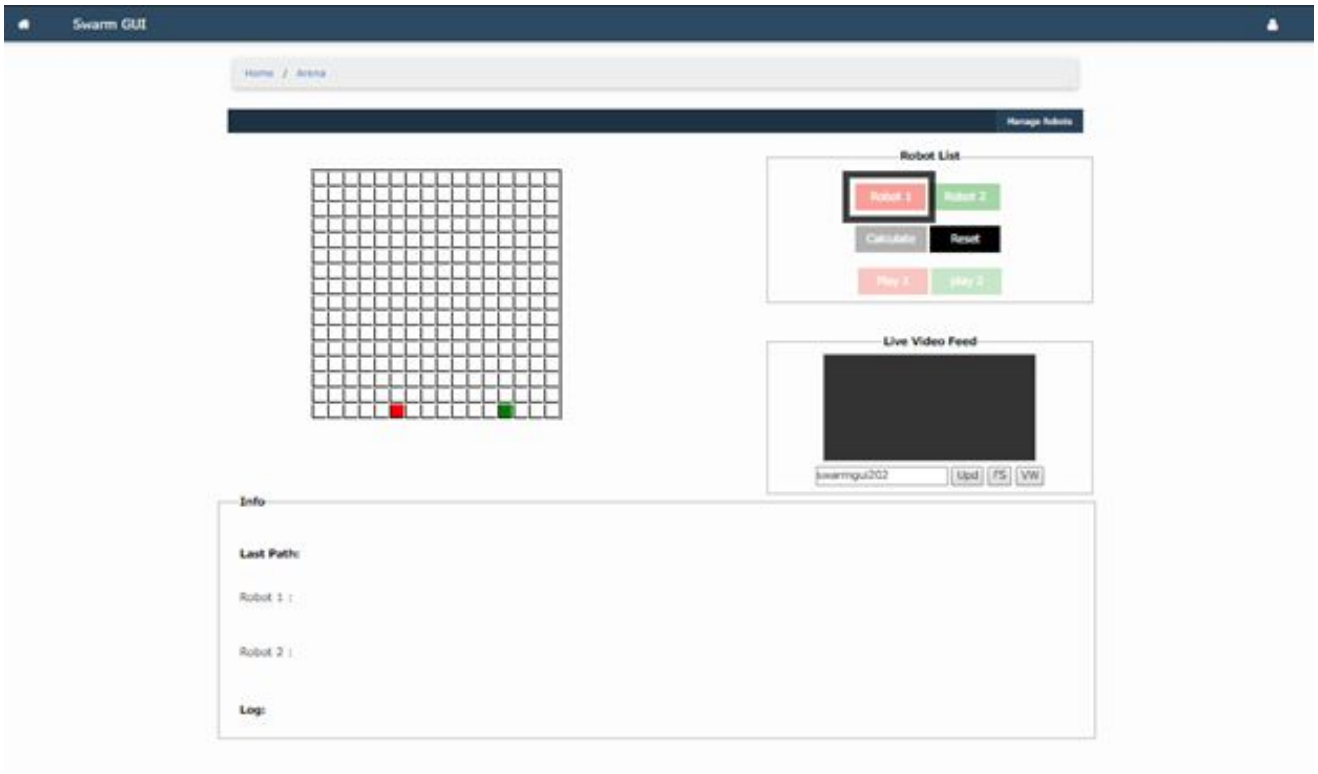
When user selects 'Add Services' link bellow screen will appear.

2.3 Connection

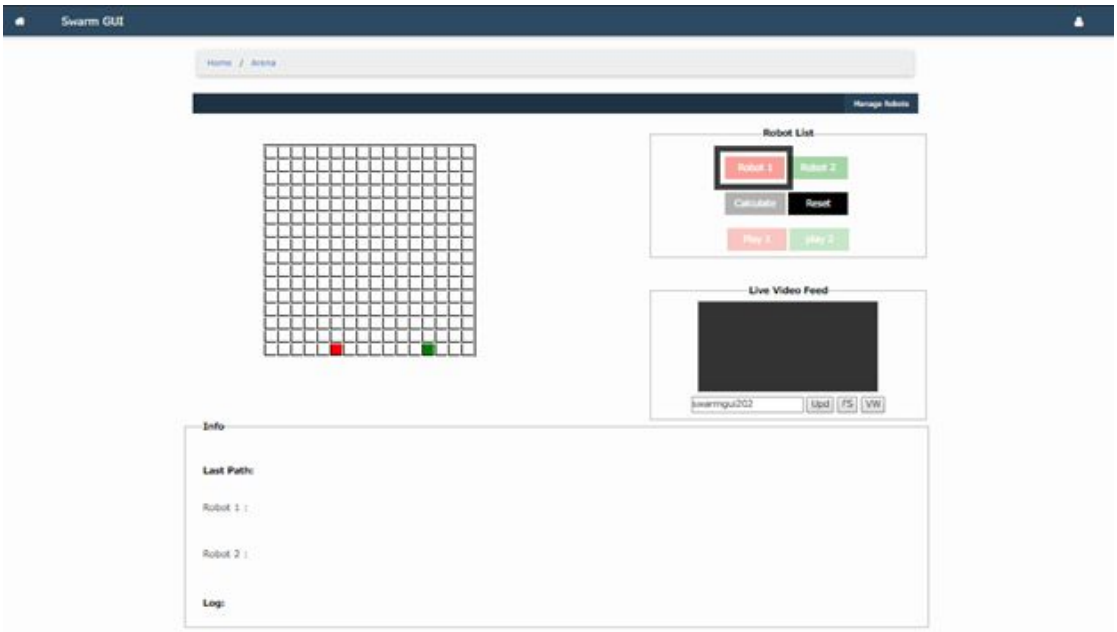


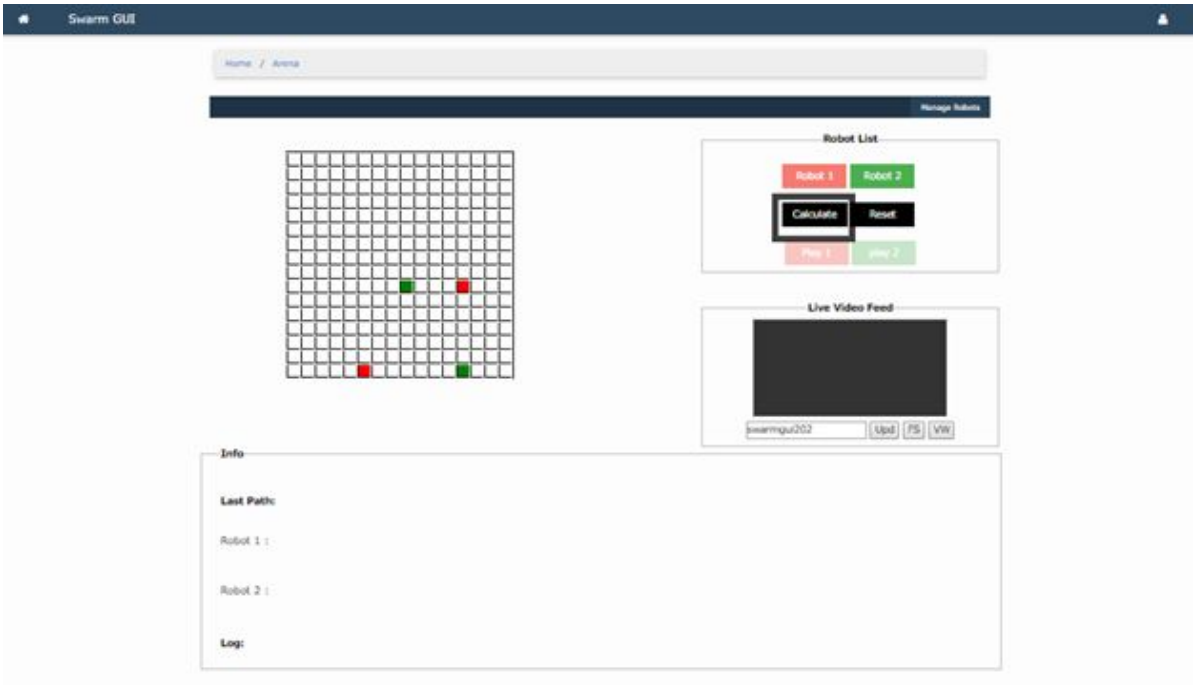
This Display the connectivity of the platform. If it is connected user can selects '**Access**' link. After that the following window will appear

3 Grid page

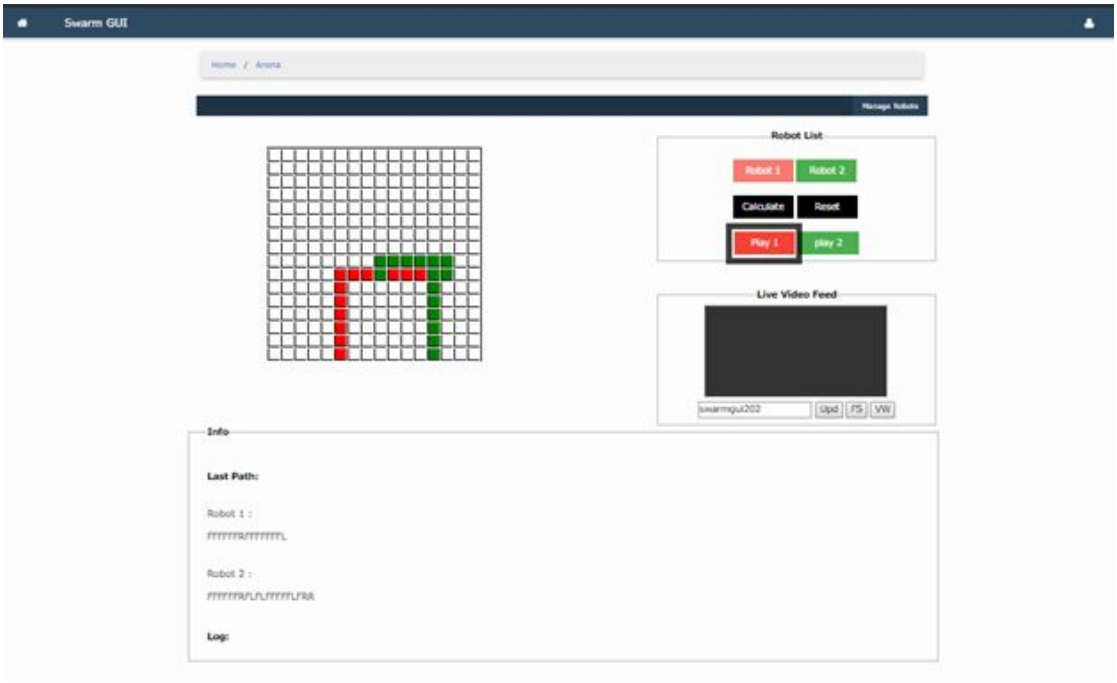


Robots should be placed in specific locations and they will be denoted in red and green color in the grid (Only two robots yet). Users can select the destinations for the robots as in the figure by clicking the particular robot and the destination point.

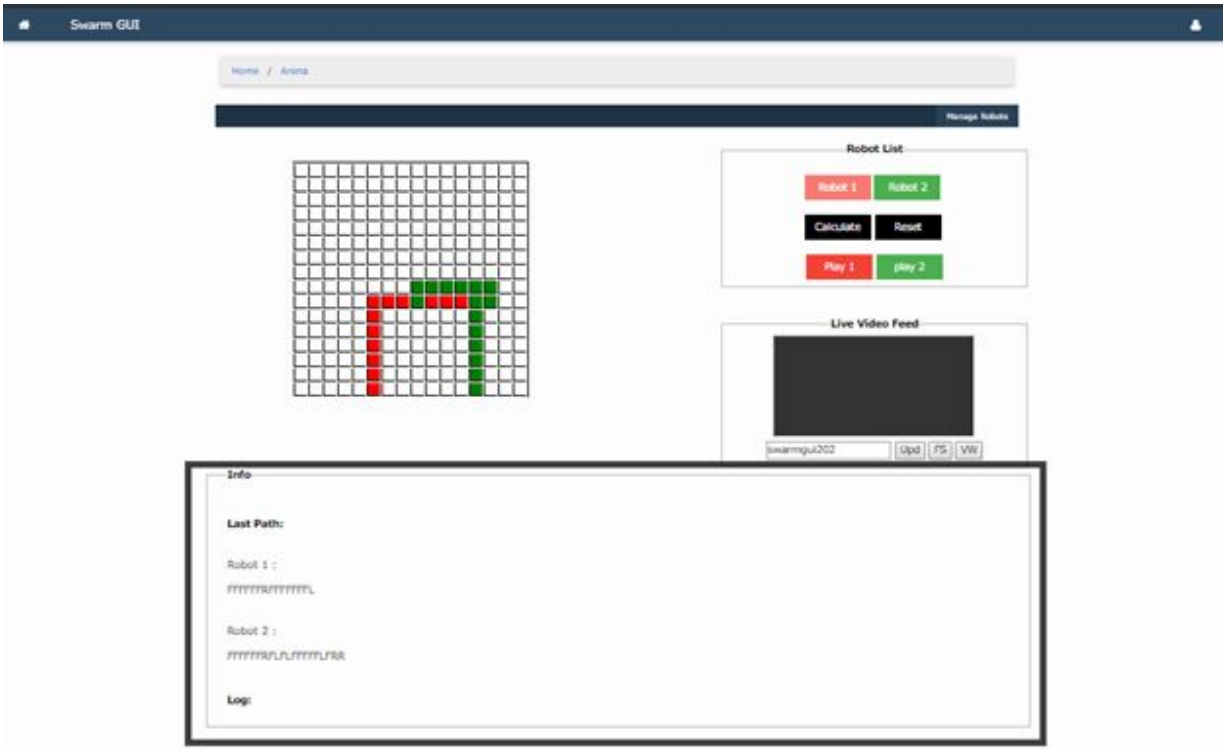


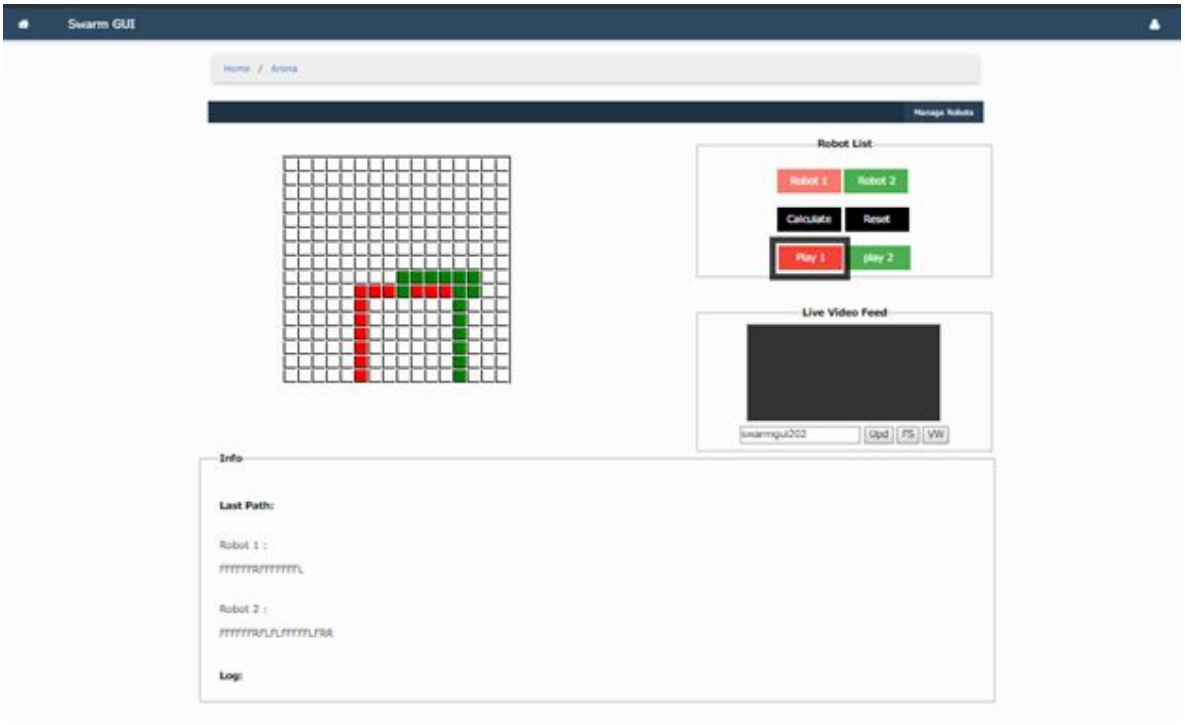


Then by clicking the '**Calculate**' button the system calculates the path for the robots by using a collision detect & prevent algorithm and it will be displayed in the grid as follows.

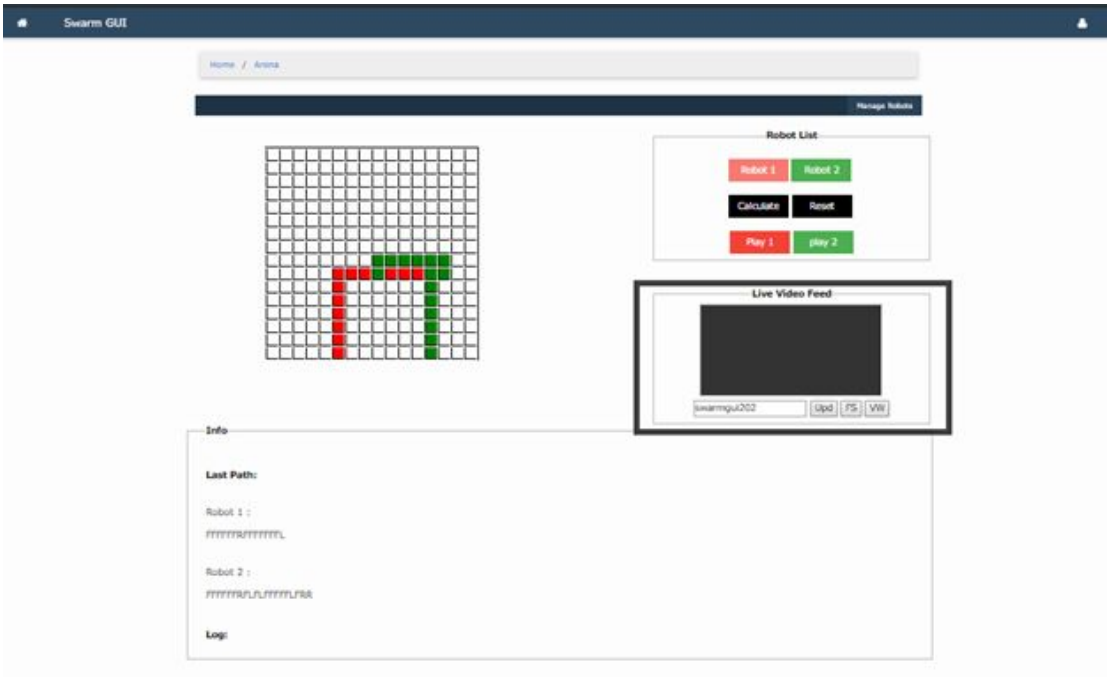


The info panel gives the path of each robot separately by the symbols 'F', 'L' and 'R' to indicate a forward, left and right respectively.





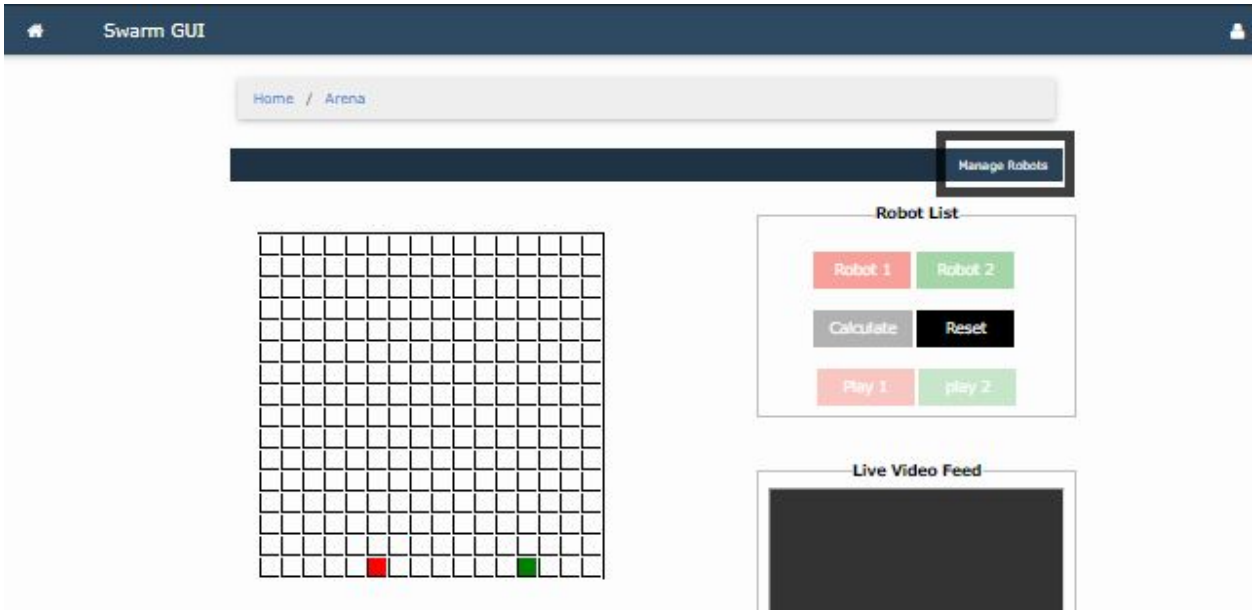
By clicking the ‘Play 1’ button it sends the path that calculate to the particular robot and the robot will move accordingly. ‘Play 2’ button does the same thing to the second robot.



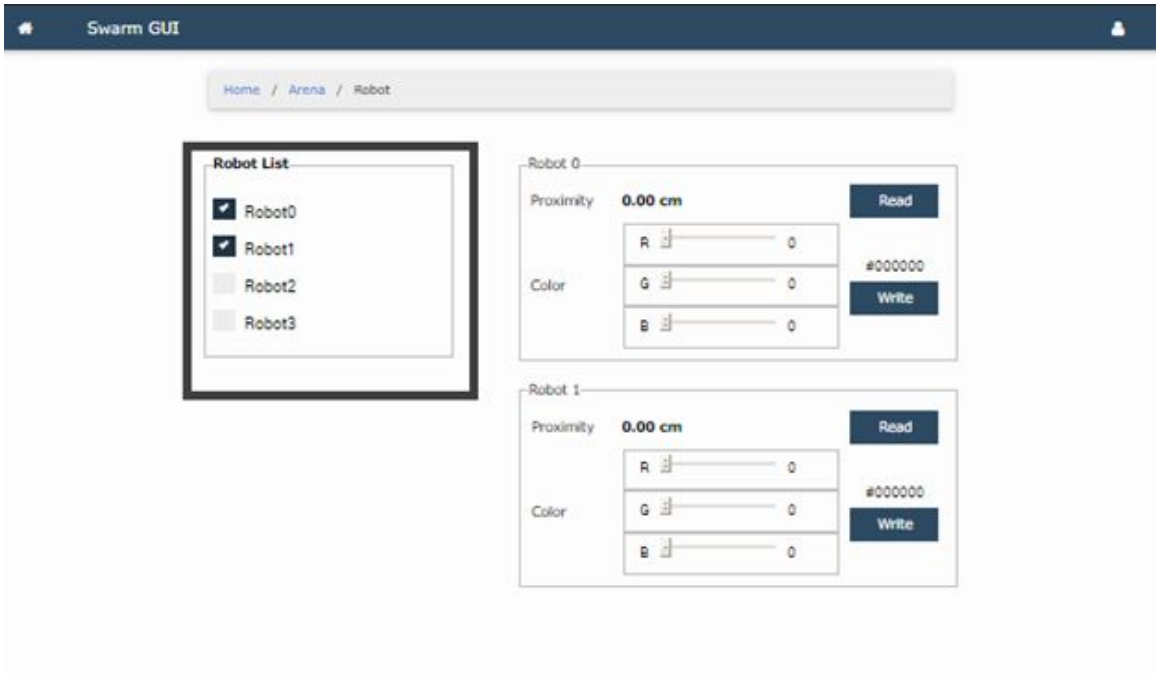
‘Live video feed’ panel gives a live video feedback of the movements of the robots.

3.1 Manage robots

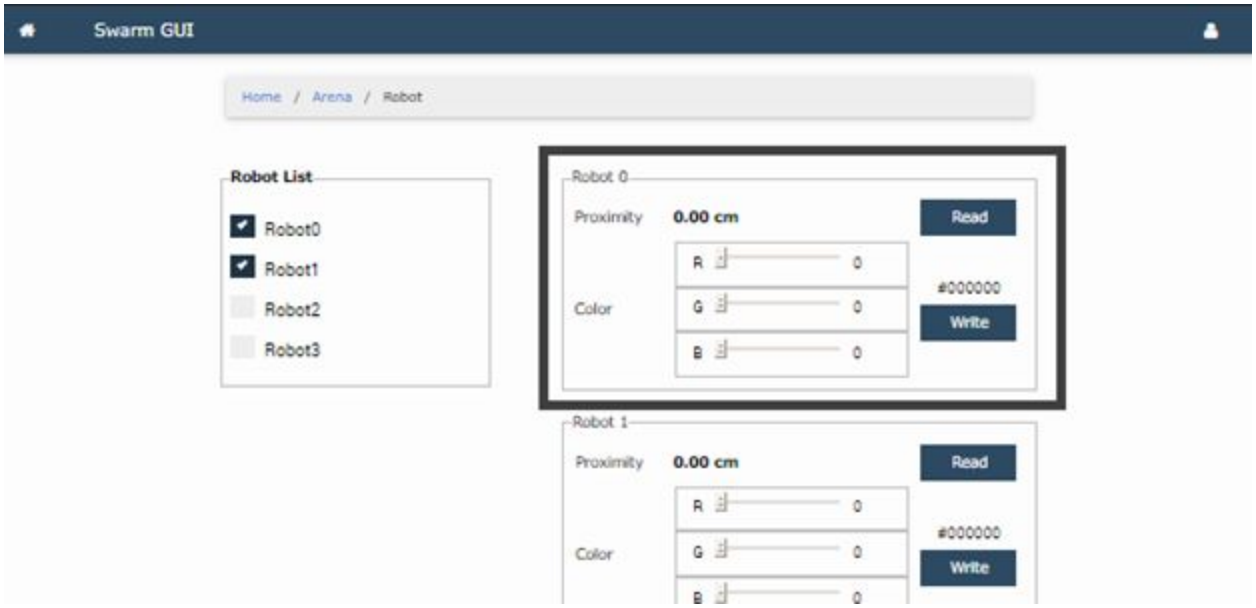
User can select ‘Manage Robots’ link to manage the robots.



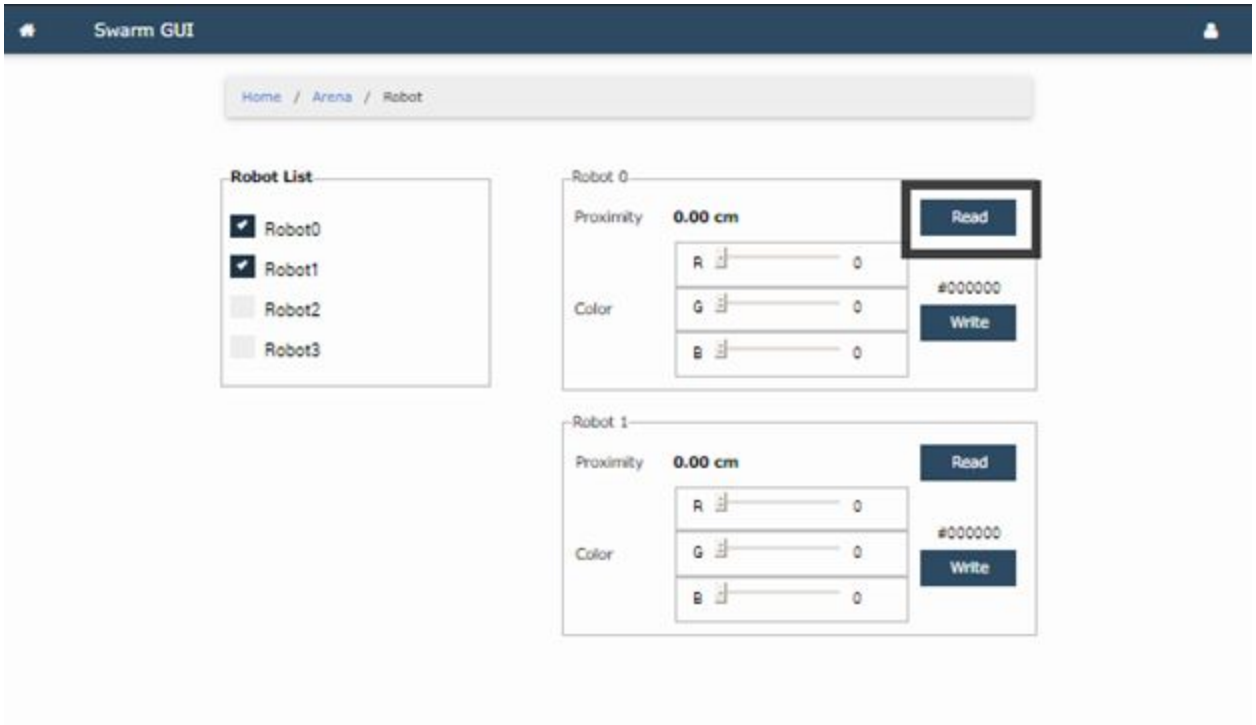
User can select robots by checking the checkboxes provided. Users can only select the active robots at that time.



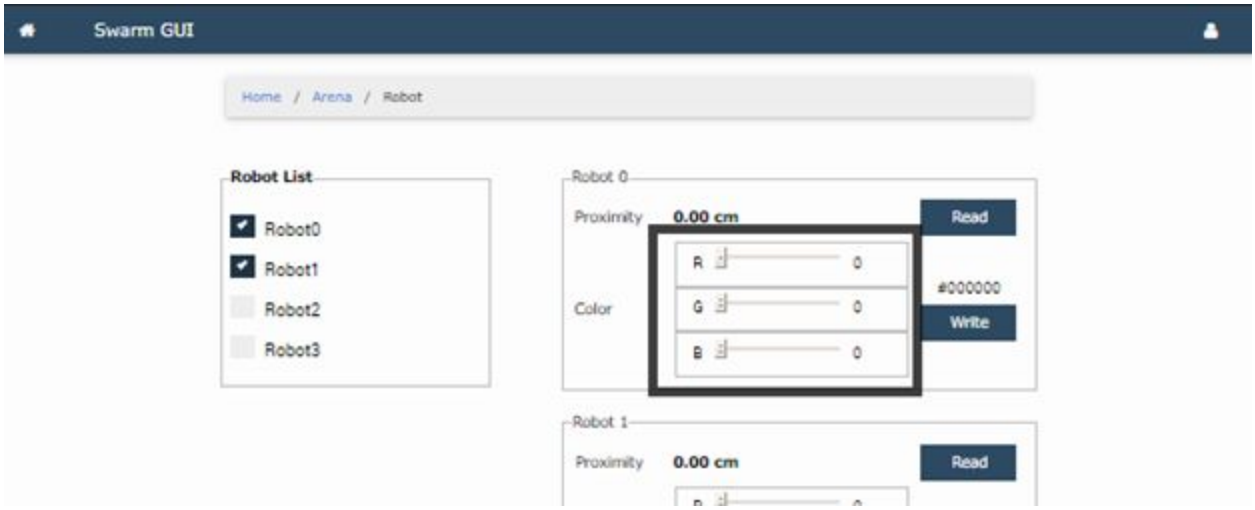
A control panel will appear for each robot when the checkbox is checked.



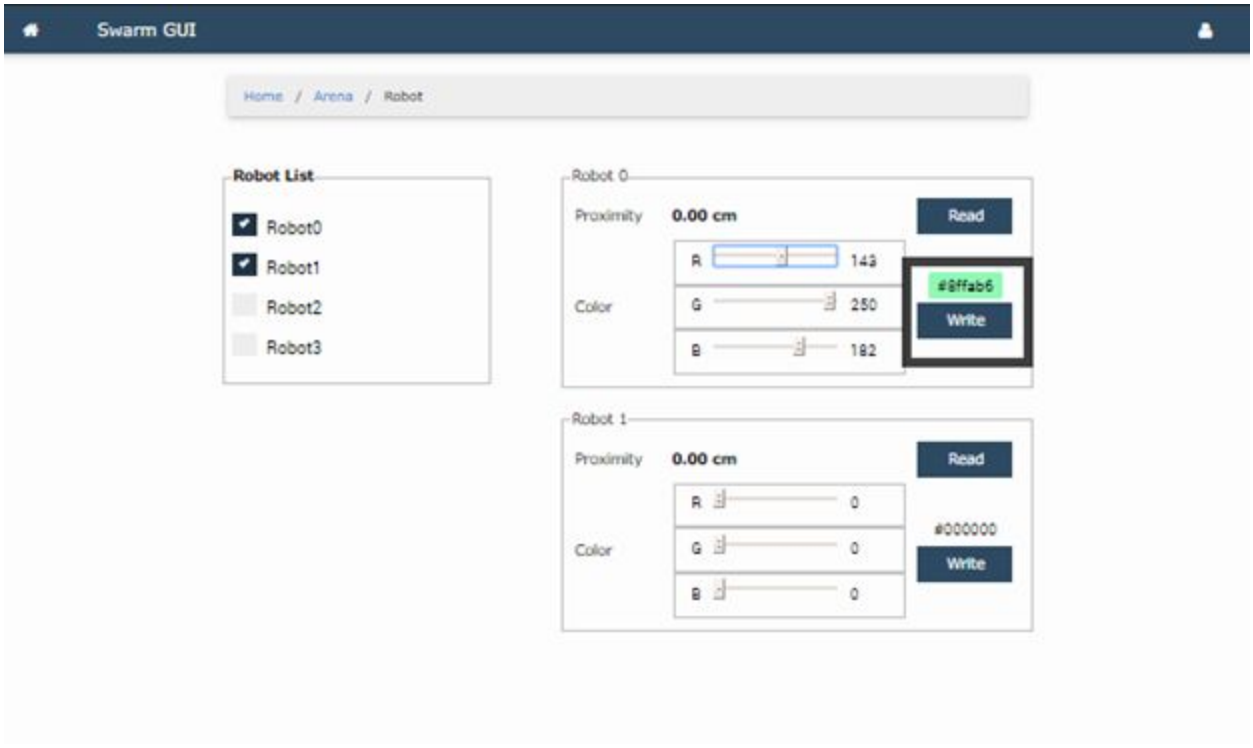
Users can read the proximity values by clicking the ‘Read’ button in the right of the proximity value.



User can change the color of the robot using the color panel which is highlighted in below image.



The color they selected will display in the color box and can be send to the robots by clicking the **'Write'** button.



API Interface

End users can obtain information from the robot and send instructions to the robot by sign in to the user portal and send HTTP GET requests to API endpoints defined as follows:

Root URL: https://swarm-gui.tk/api/v1

Note: Root URL may subject to change/update

Scan and identify available robots

Request:

/GET **{Root URL}**/robots/scan/:arenaId

Parameter	Description
arenaId	ID of the simulation arena. (Ex: 1000)

Example Response:


```
{
  "auth": {
    "arenaId": 1000,
    "upToken": "b97fc818b0005f7a9e8e3230b670a535"
  },
  "topic": "scan",
  "type": "reply",
  "jobId": 100001,
  "data": {
    "ips": {
      "0": "192.168.43.102"
    }
  }
}
```

Obtaining the proximity reading of a robot

Request:

/GET **{Root URL}**/proximity/:arenaId/:robotId

Parameter	**Description**
arenaId	ID of the simulation arena. (Ex: 1000)
robotId	ID of the robot, given by the scan/robot request. This is an increment number assigned to the robots connected into simulation arena, starting from 0

Example Response:


```
{
  "auth": {
    "arenaId": 1000,
    "upToken": "b97fc818b0005f7a9e8e3230b670a535"
  },
  "topic": "proximity",
  "type": "reply",
  "jobId": 100002,
  "response": "Success",
  "data": {
    "raw": "25",
    "filtered": "25.000000",
    "robotId": "0"
  }
}
```

Send the moving path to a robot

Request:

/GET **{Root URL}**/path/:arenaId/:robotId/:pathString

Parameter	**Description**
arenaId	ID of the simulation arena. (Ex: 1000)
robotId	ID of the robot, given by the scan/robot request. This is an increment number assigned to the robots connected into simulation arena, starting from 0
pathString	A string that contains the path to move. Robot will execute this string char by char. F: Go forward one cell distance R: Turn right L: Turn left W: Wait for a time

Example Response:


```
{
  "auth": {
    "arenaId": 1000,
    "upToken": "b97fc818b0005f7a9e8e3230b670a535"
  },
  "topic": "path",
  "type": "reply",
  "jobId": 100005,
  "response": "Success",
  "data": {
    "robotId": "0"
  }
}
```

Update the color of a robot

Request:

/GET **{Root URL}**/color/:arenaId/:robotId/:redValue/:greenValue/:blueValue/

Parameter	**Description**
arenaId	ID of the simulation arena. (Ex: 1000)
robotId	ID of the robot, given by the scan/robot request. This is an increment number assigned to the robots connected into simulation arena, starting from 0
redValue	The intensity of the color red. Value should be an 8 bit integer. *Value: [0 - 255]*
blueValue	The intensity of the color blue. Value should be an 8 bit integer. *Value: [0 - 255]*
greenValue	The intensity of the color green. Value should be an 8 bit integer. *Value: [0 - 255]*

Example Response:


```
{
  "auth": {
    "arenaId": 1000,
    "upToken": "b97fc818b0005f7a9e8e3230b670a535"
  },
  "topic": "color",
  "type": "reply",
  "jobId": 100003,
  "response": "Success",
  "data": {
    "robotId": "0",
    "red": "10",
    "green": "0",
    "blue": "0"
  }
}
```