CMPE281 - Campus Security Robot

Presented by GROUP 17 -

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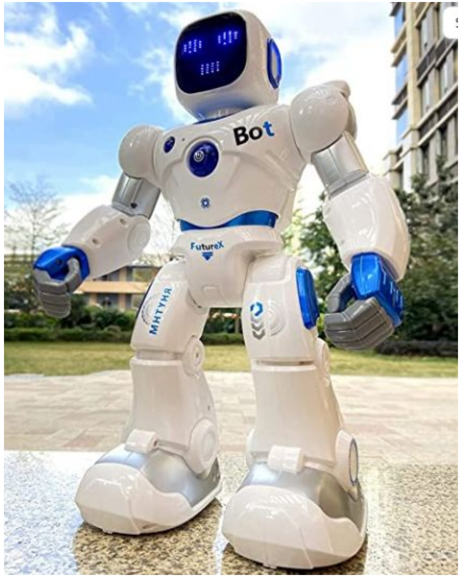
Project Overview

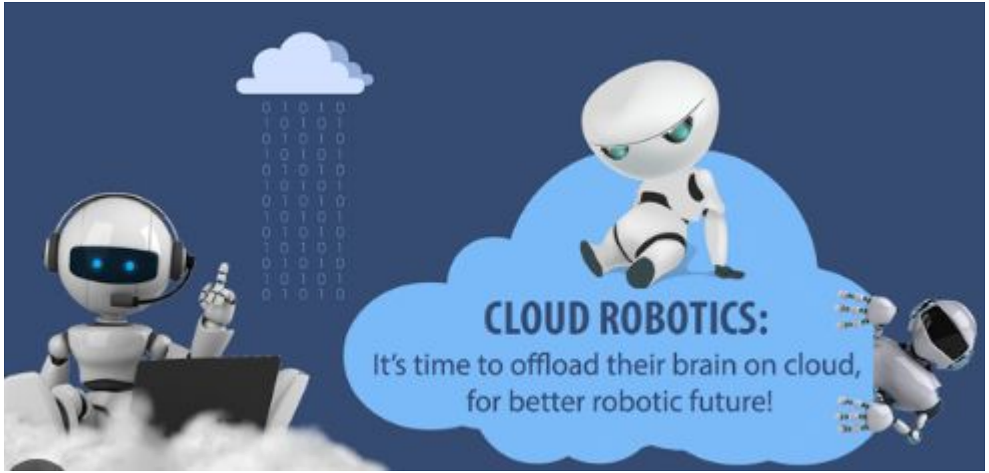
Project Overview

- This is a cloud-based service/platform for mobile Campus Security robots that allows communication between the robots and a cloud server
- This robot cloud service will handle robot operations and business model for Campus Security Robots
- The operations supported by our application will be able to :
  - Create
  - Configure
  - Command
  - Monitor Robots
- Other services provided will be :
  - User Management
  - Robot catalogs
  - Billing services



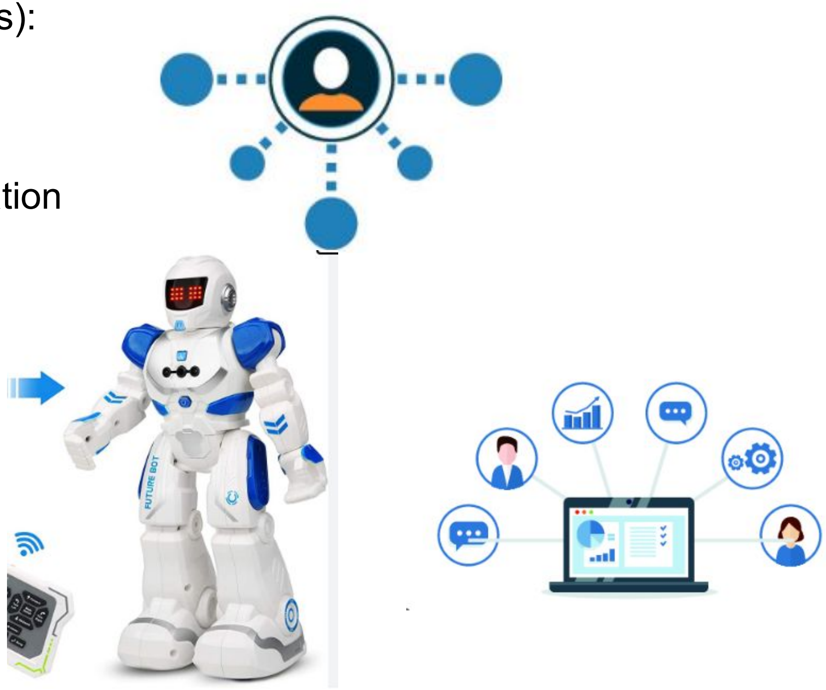
Project Scope

- Robot is supposed to move around the school environment.
- It will detect the students and convey the information back to Robo Cloud
- Robot can be scheduled to move around the school environment
- A Robo cloud system with
    - scalability
    - multitenancy
    - load balancing


CLOUD ROBOTICS:
It's time to offload their brain on cloud, for better robotic future!

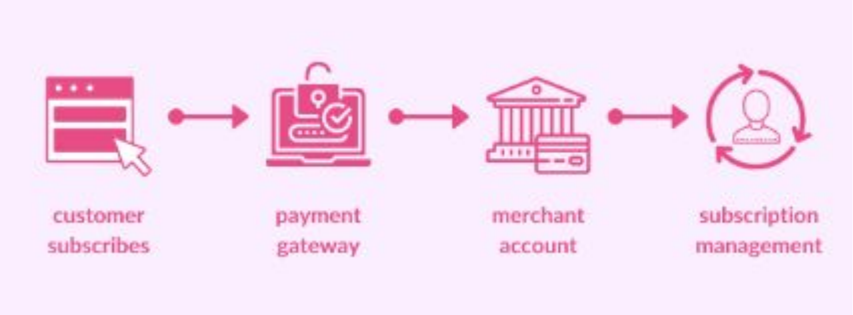
Functional Requirements

- User Management(Support for multiple users):
  - College Staff Users(Customers)
  - System Admin(Business Users)
- Account Management
  - User account creations and authentication
  - User role creation
- Robot Management
  - Create a Robot
  - Configure Robot
  - Schedule Robot
  - Tracking Robot

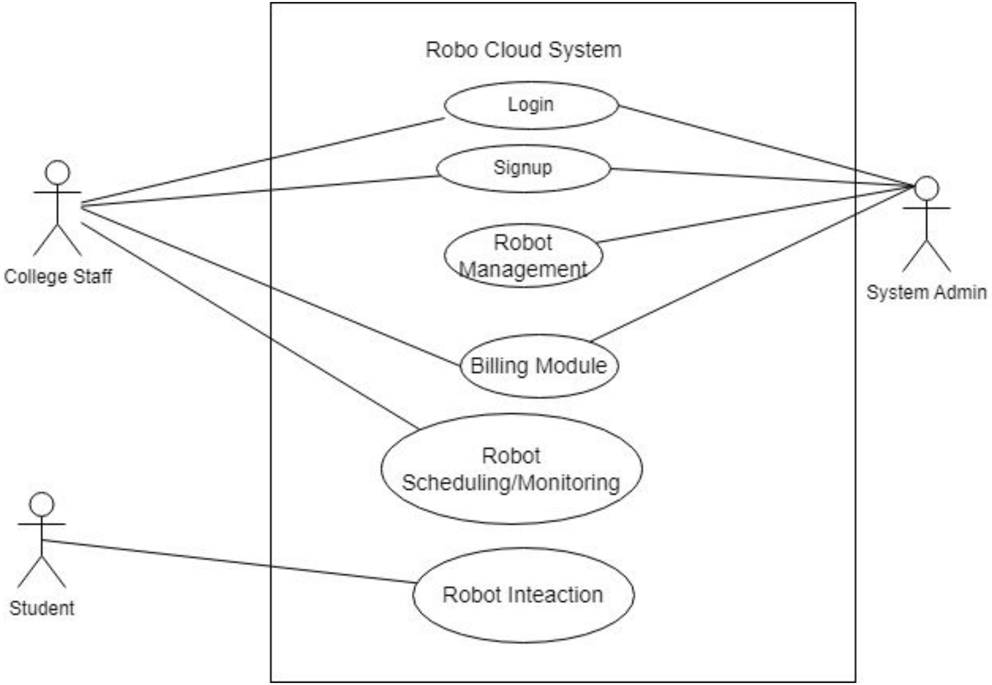


Functional Requirements

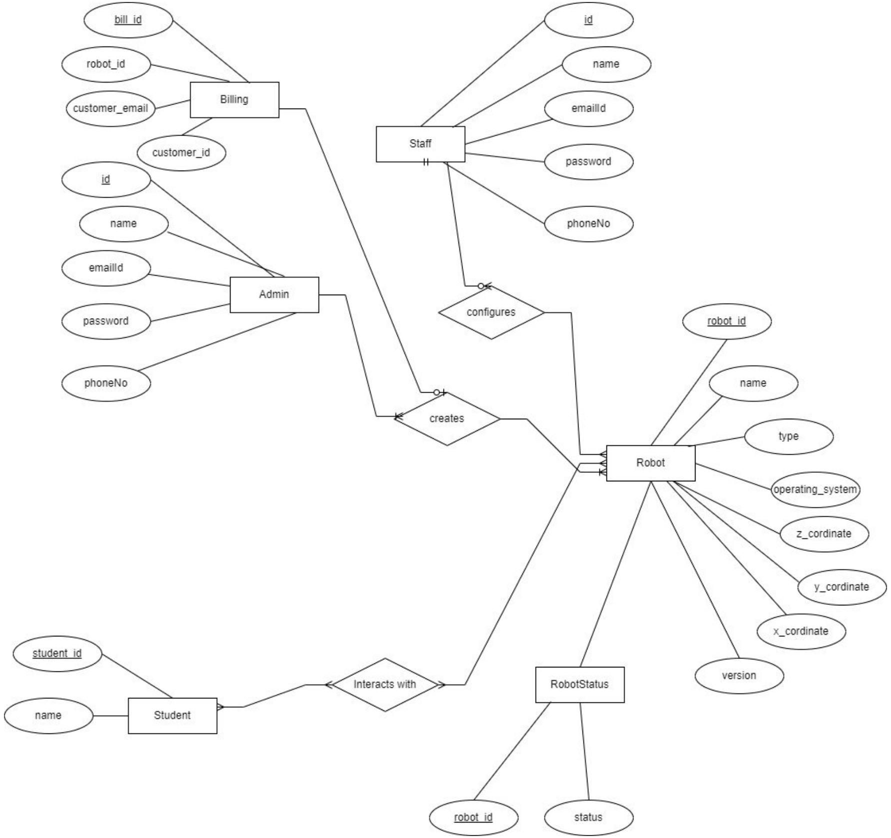
- Billing Management
  - Calculate Robot rental based on active robot time
  - Generate Bill
  - Maintain records for scheduled robots and payments
- Statistics
  - Display all associated Robots
  - Display all bills generated for particular user
- Cloud Application(SaaS)
  - Customer Portal
  - Admin Portal



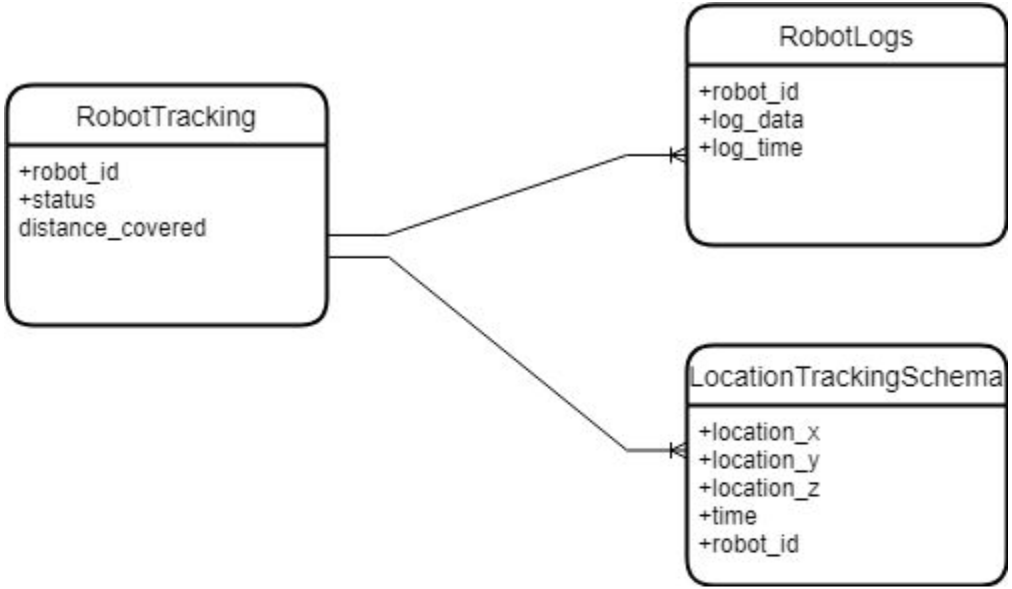
Use Case diagram for RoboCloud



SQL Database Schema for RoboCloud



Mongo Database Schema for RoboCloud



RobotTracking

+robot_id
+status
distance_covered

RobotLogs

+robot_id
+log_data
+log_time

LocationTrackingSchema

+location_x
+location_y
+location_z
+time
+robot_id

Project System design

CSR System Design

Our Robot cloud service consists of four major components:

1. **Web Application -**

   The web application is supposed to be used by the college staff and the administrator to configure robot and assign the robots particular tasks that needs to be done.

2. **AWS Cloud Server-**

   This server was responsible for all the backend task and communication between the database. Here, we developed services that are responsible for robot Management, User Registration, Security management, and big data management

3. **Robot Simulation Application-**

   We treated webots as a black box and used it to stimulate our virtual robots and virtual environments. We also connected our backend services to Webots.

4. **Database servers-**

   We used SQL databases for storing all the user information and the state of robots and the information related to billing and other modules. We also used MongoDB database to store the logs and statistics of Robot which we will be getting from Webots. All the data in Mongo will come from our simulation software via our backend server. This data was used for logging purposes.

CSR System Design (System Deployment Infrastructure)

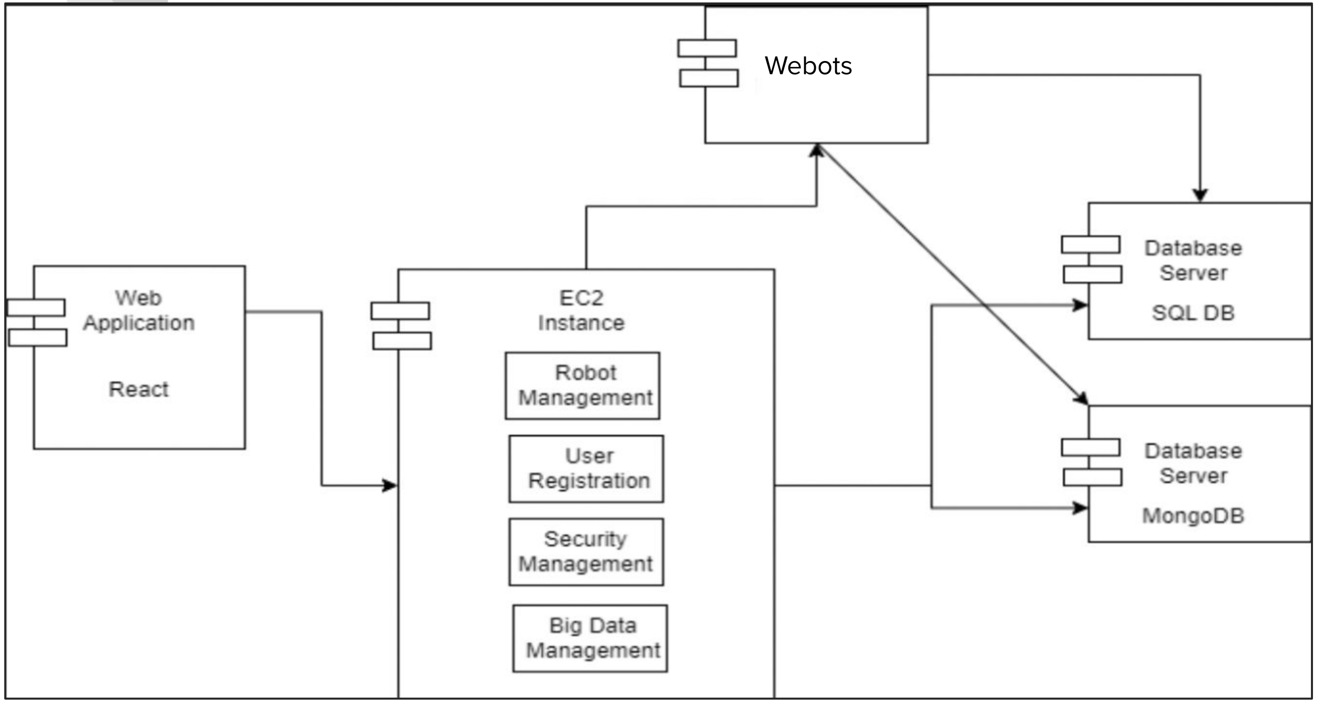


Figure 2.1

Fig 2.1 shows the physical view of the system in terms of hardware boxes, how they are connected, and the users who use them.

Tech Stacks Used for Campus Security Robot

EmailJS

Webots

robot simulation

MongoDB®

stripe

aws

node JS

React

IJ

SQL

Persona

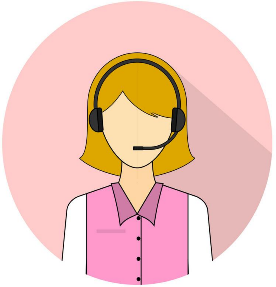
We have designed the application for two types of users-

1. The general User

2. The System Admin

Students

College Administration

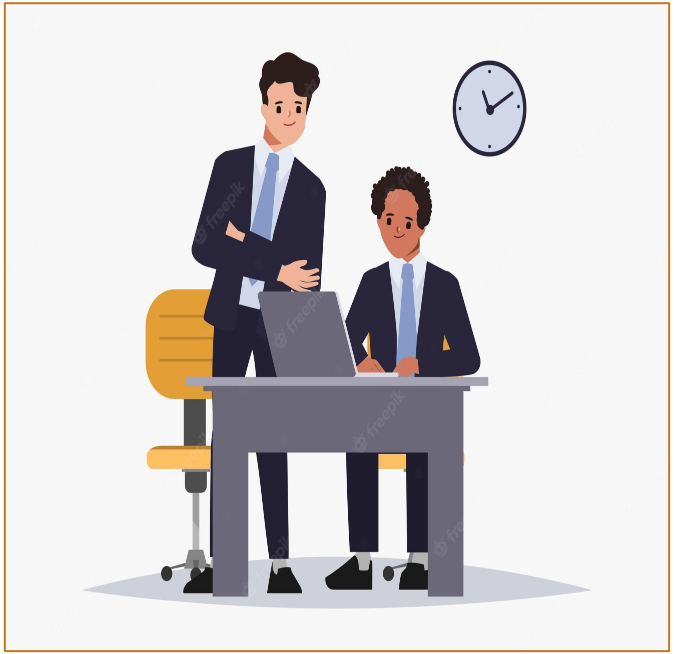


Admin

The General User- College Administration

College Admin and Service Staff are able to perform following functionality-

1. Monitor and track the attendance of all students via dashboard connected to CSR.
2. Upload the student database of valid recipients for events.
3. Receive an alert when an unauthorized person tries to trespass the event.

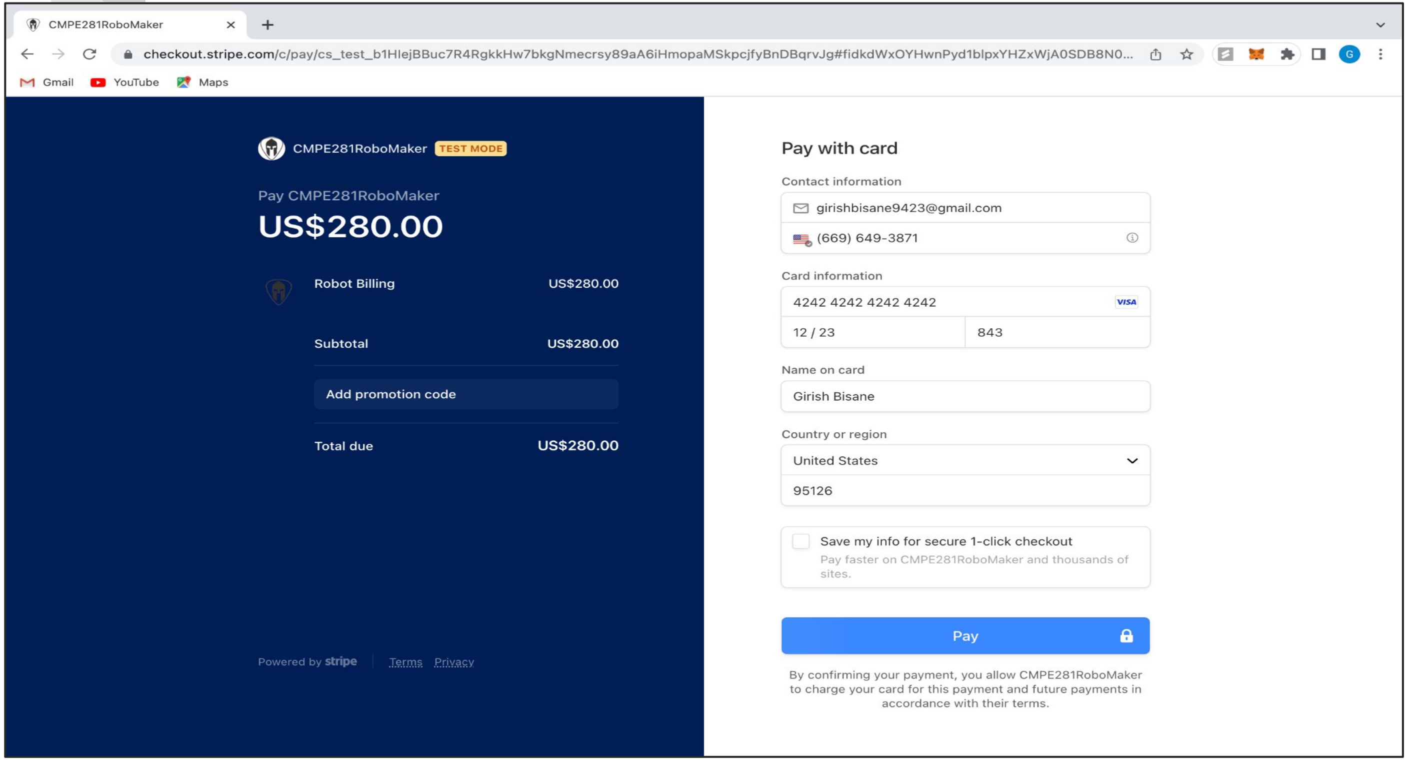


The General user- System Admin

System Admin are able to perform following functionality-

1. Assign and Control the role access for users from Access Management Tab.
2. Generate Bill and Send regular reminder to the clients for the usage of robot.

Additional Features- Payments



CMPE281RoboMaker
checkout.stripe.com/c/pay/cs_test_b1HlejBBuc7R4RgkkHw7bkgNmecrsy89aA6iHmopaMSkpcjfyBnDBqrvJg#fidkdWxOYHwnPyd1blpxYHZxWjA0SDB8N0...
Gmail
YouTube
Maps

CMPE281RoboMaker TEST MODE

Pay CMPE281RoboMaker

US$280.00

Robot Billing	US$280.00
Subtotal	US$280.00
Add promotion code	
Total due	US$280.00

Powered by stripe | Terms Privacy

Pay with card

Contact information

girishbisane9423@gmail.com

(669) 649-3871

Card information

4242 4242 4242 4242 VISA

12 / 23 843

Name on card

Girish Bisane

Country or region

United States

95126

□ Save my info for secure 1-click checkout
Pay faster on CMPE281RoboMaker and thousands of sites.

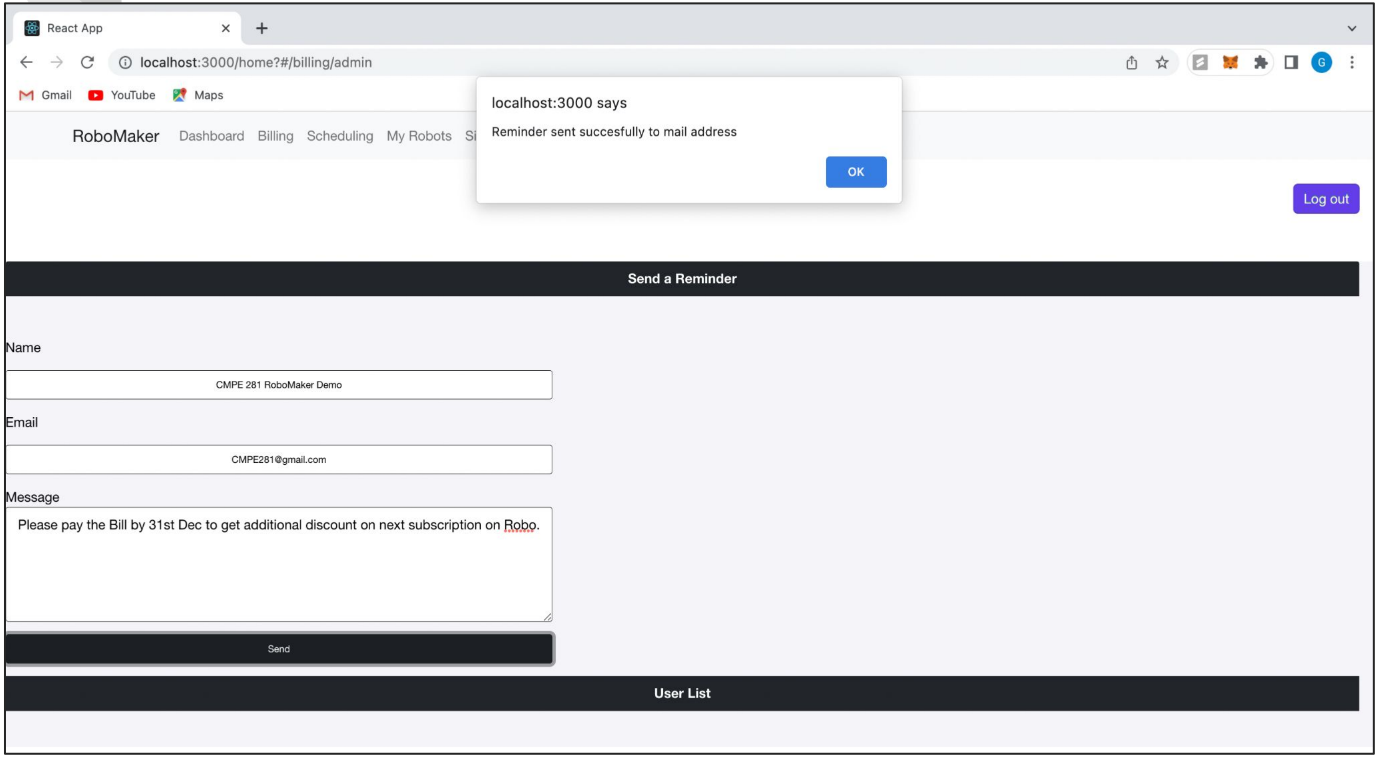
Pay

By confirming your payment, you allow CMPE281RoboMaker to charge your card for this payment and future payments in accordance with their terms.

We integrated our Billing module with Stripe API to get the real time payments and track all the transaction used to pay the Bills.

Admin will now be able to see all the transaction history in his dashboard.

Additional Features- Email Reminder



localhost:3000 says

Reminder sent succesfully to mail address

OK

Send a Reminder

Name: CMPE 281 RoboMaker Demo

Email: CMPE281@gmail.com

Message: Please pay the Bill by 31st Dec to get additional discount on next subscription on Robo.

Send

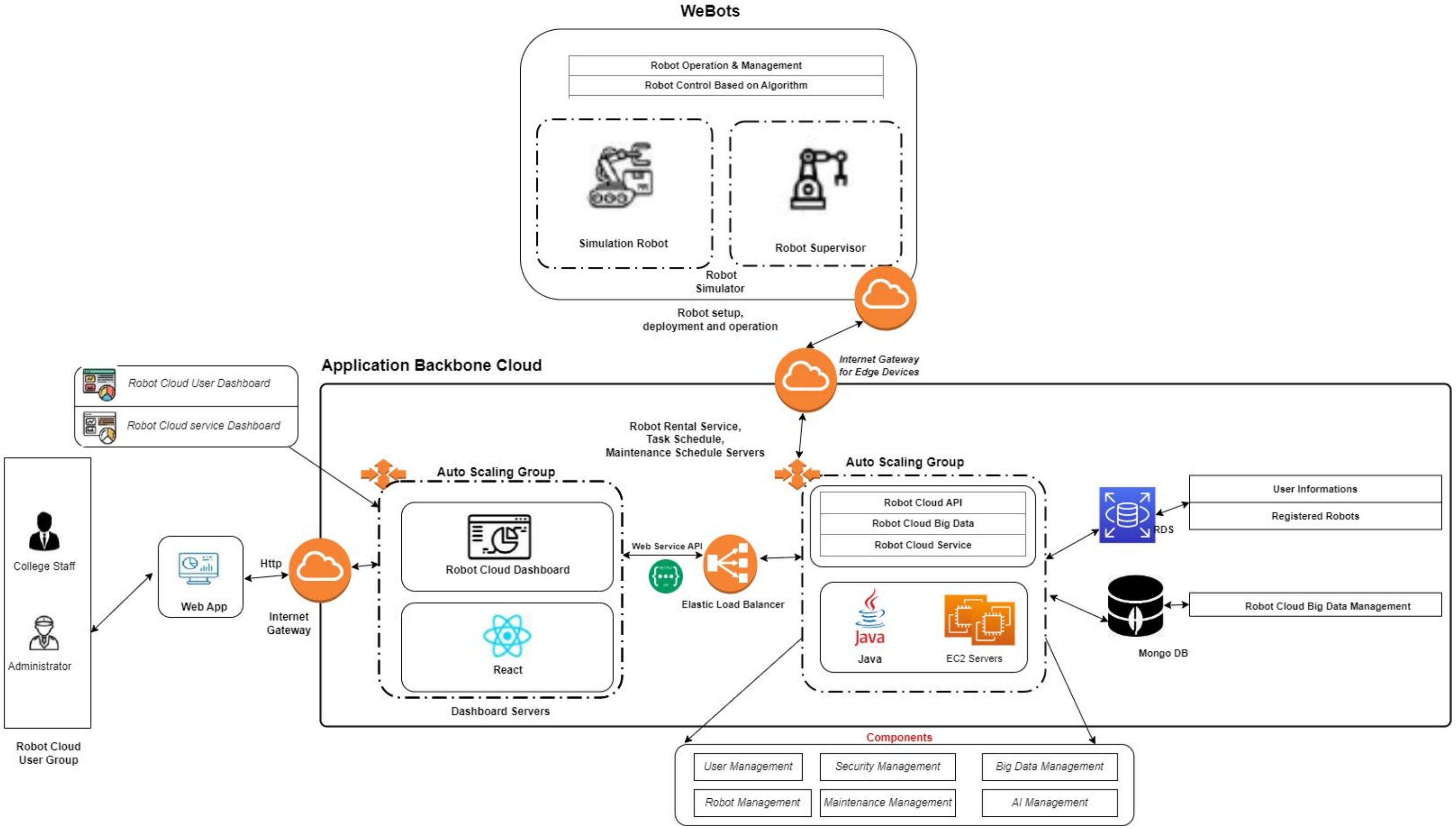
User List

Admin will be able to send Reminder to users for usage of Robot.

Clients will receive a mail prior to deadline to pay the Bill at earliest.

Cloud system design

Cloud Architecture



WeBots

Robot Operation & Management

Robot Control Based on Algorithm

Simulation Robot

Robot Supervisor

Robot Simulator

Robot setup, deployment and operation

Internet Gateway for Edge Devices

Application Backbone Cloud

Robot Cloud User Dashboard

Robot Cloud service Dashboard

Robot Rental Service, Task Schedule, Maintenance Schedule Servers

Auto Scaling Group

Auto Scaling Group

College Staff

Administrator

Robot Cloud User Group

Web App

Http

Internet Gateway

Robot Cloud Dashboard

React

Dashboard Servers

Web Service API

Elastic Load Balancer

Robot Cloud API

Robot Cloud Big Data

Robot Cloud Service

Java

EC2 Servers

RDS

User Informations

Registered Robots

Mongo DB

Robot Cloud Big Data Management

Components

User Management

Security Management

Big Data Management

Robot Management

Maintenance Management

AI Management

Components in Cloud Architecture

The cloud architecture has following components:

1. **Application Backbone Cloud** - Backend and frontend are hosted here on an EC2 instance.
2. **Databases** - The hosted backend is connected to AWS RDS and MongoDB Cloud instances.
3. **Webots** - The backend is connected to webots supervisor controller that controls the robot program. The simulation runs in Webots.

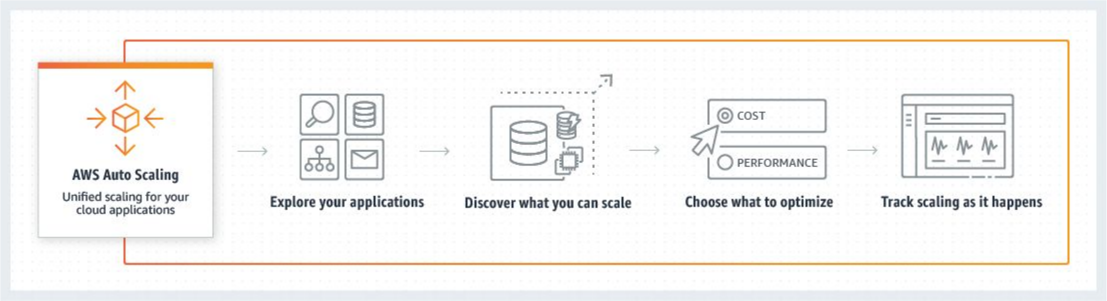
User groups:

1. College Staff/Students
2. Admin

Scalability - Auto-scaling

Auto-scaling in AWS ensures good performance of the application.

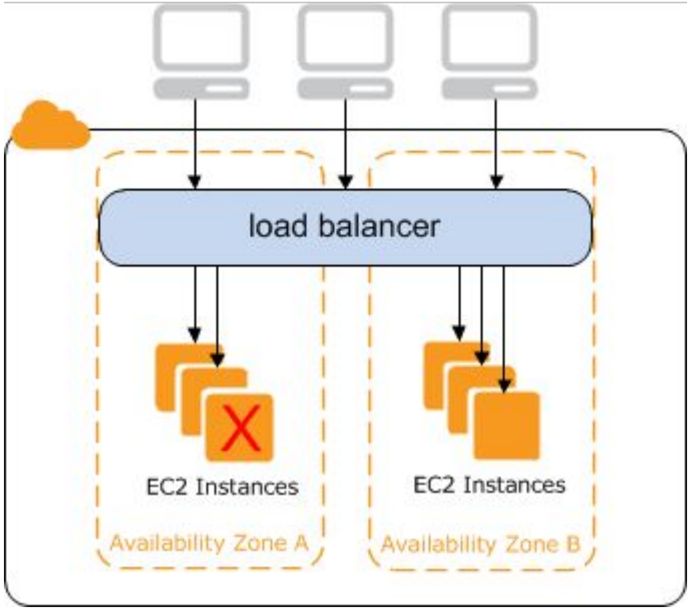
The main feature here is to adjust the capacity (memory, processing power) based on requirement hence maintaining low costs.


AWS Auto Scaling
Unified scaling for your cloud applications
Explore your applications
Discover what you can scale
COST
PERFORMANCE
Choose what to optimize
Track scaling as it happens

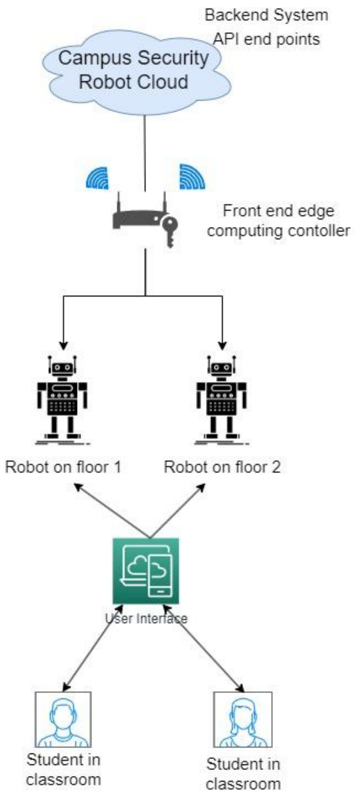
Load Balancing

AWS load balancer helps create better availability of an application and increases fault tolerance if the network traffic becomes extremely high.

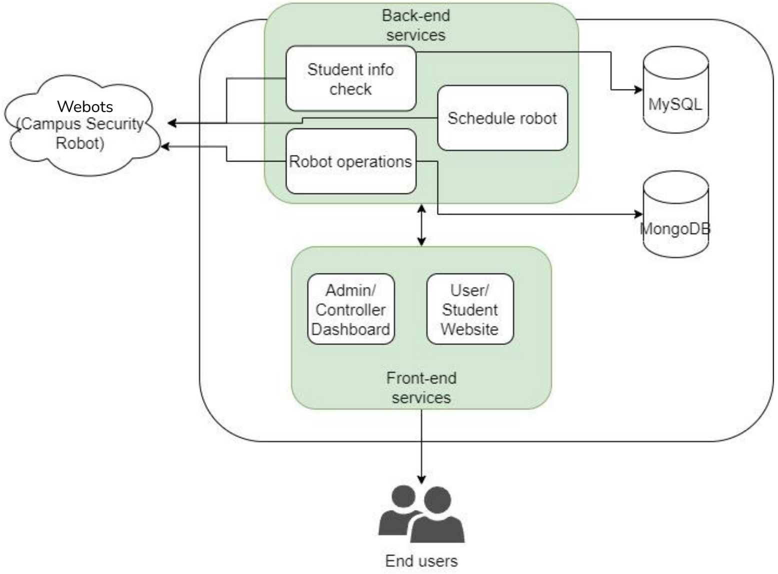
This is achieved by adjusting compute resources like EC2 instances based on the load coming from requests.



Cloud-based Component Design



End users interact with the frontend UI, which interacts with the backend server that has APIs for interacting with the deployed robot. It also connects to both databases and can give the user information in the format they want if they ask for it.



Team And Partition work

Team Work

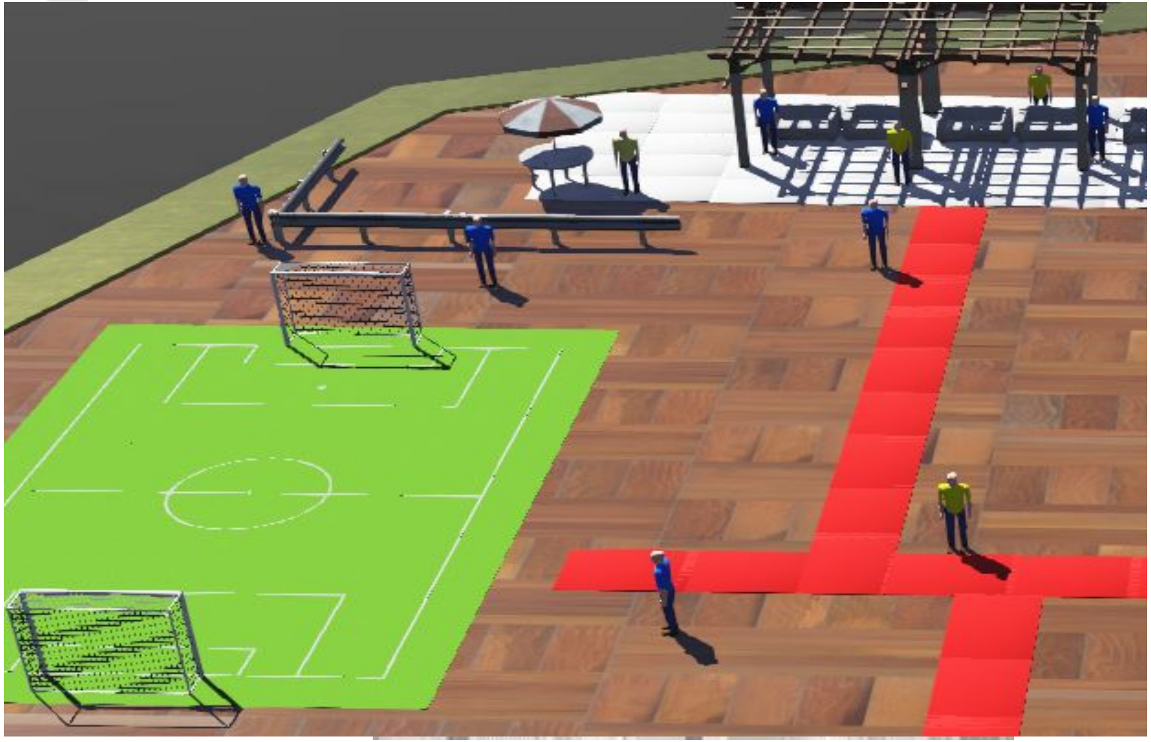
Rajat Prashant Masurkar : Database management component(s) Responsible for creating the SQL schema Backend services related to those schema + backend

Vinti Jain: Online system dashboard Front-end + backend + webots simulation

Venkata Siva Prasad Kakkera: Edge-based mobile robot (Simulator) + backend

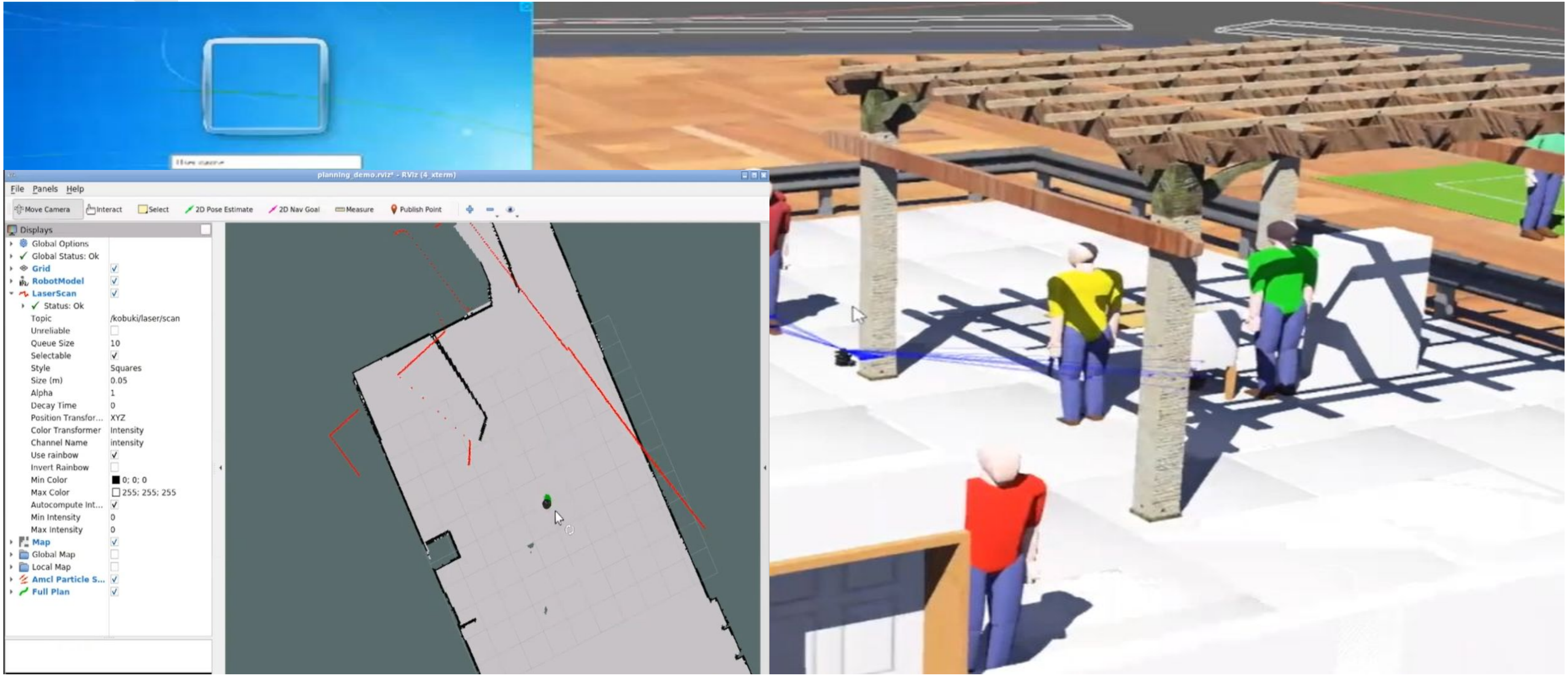
Girish Bisane: User service and billing management + backend

Additional Features- Robot map



- The route between origin and destination, as recommended by the API, complete with time and distance data in separate rows.

Additional Features (Security Robo Tracking)

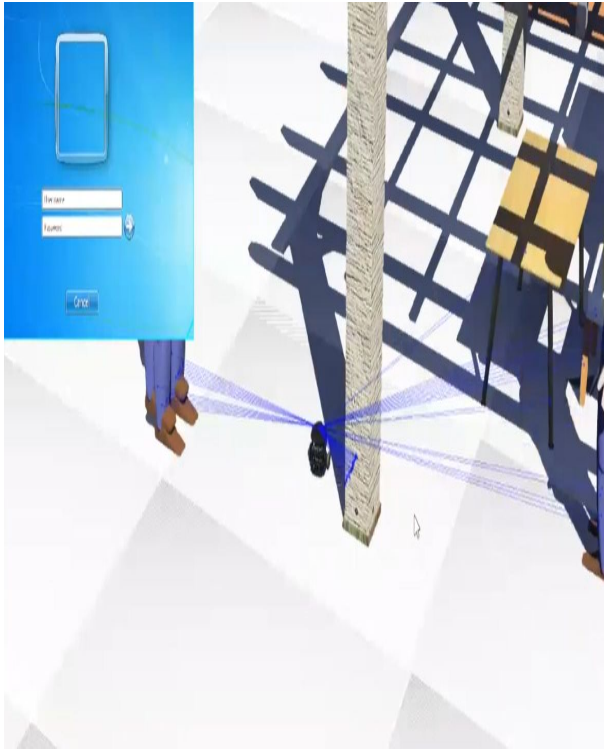


Global Options	
✓ Global Status: Ok	
Grid	☑
RobotModel	☑
LaserScan	☑
✓ Status: Ok	
Topic	/kobuki/laser/scan
Unreliable	□
Queue Size	10
Selectable	☑
Style	Squares
Size (m)	0.05
Alpha	1
Decay Time	0
Position Transfor...	XYZ
Color Transformer	Intensity
Channel Name	intensity
Use rainbow	☑
Invert Rainbow	□
Min Color	■ 0; 0; 0
Max Color	□ 255; 255; 255
Autocompute Int...	☑
Min Intensity	0
Max Intensity	0
Map	☑
Global Map	□
Local Map	□
Amcl Particle S...	☑
Full Plan	☑

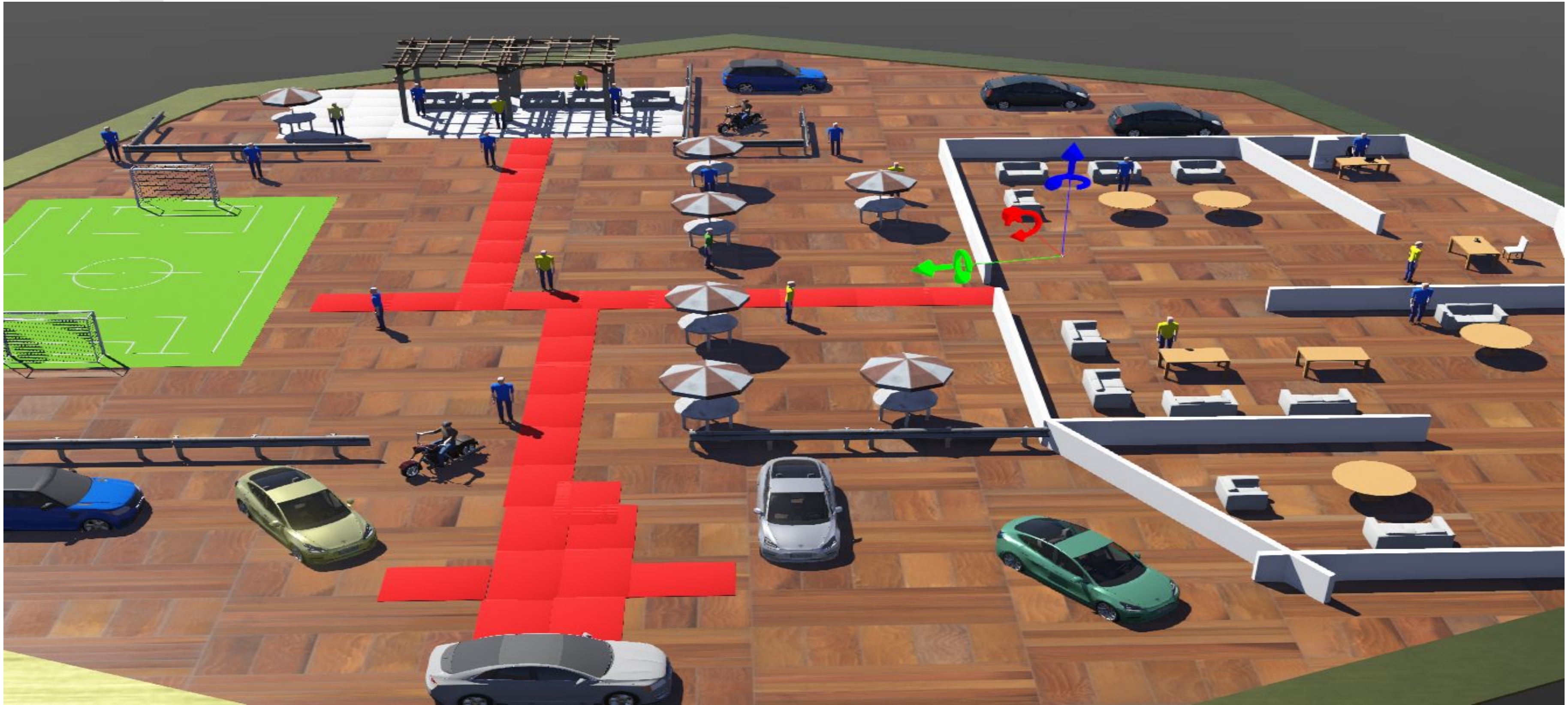
Security Robot Sensor:

Security robots travel autonomously along the inspection route, identify strangers, and send alerts to the guards.

- A system that automatically restricts movement based on technical vision systems.
- Video surveillance system that uses a pan-tilt-zoom (PTZ) camera to identify people, recognize faces, and follow moving persons.

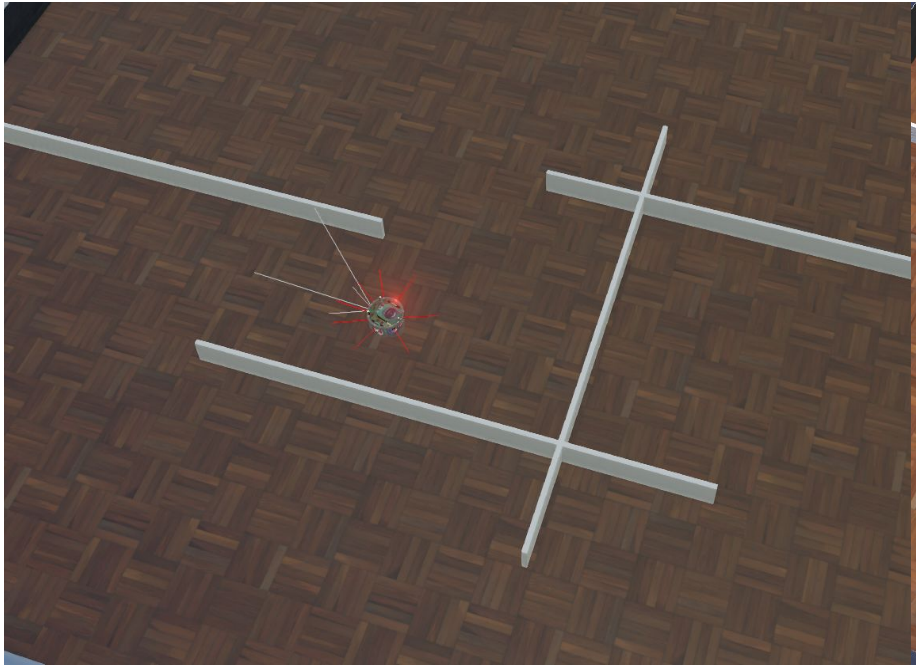


Security Robot Simulation World

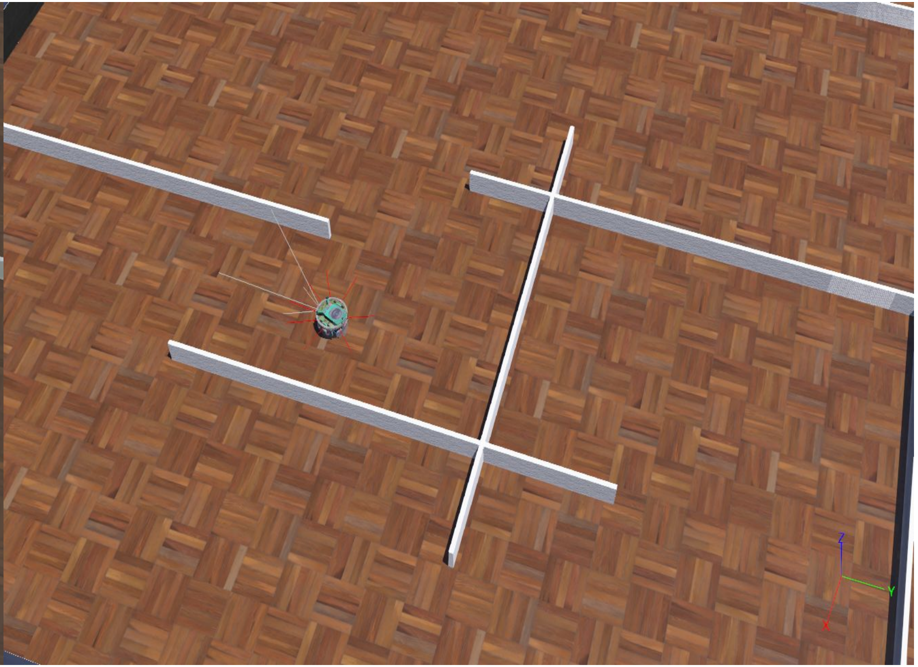


Security Robot Inner World Simulation

Night View

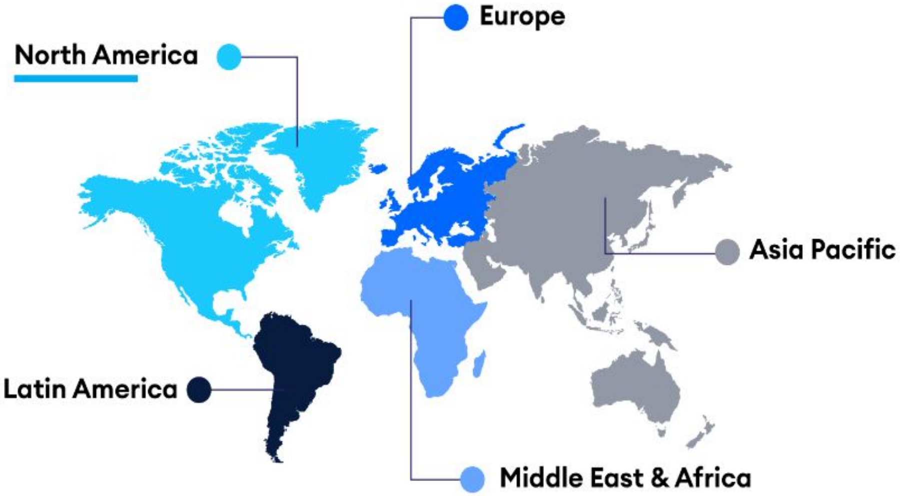


Day View



Future Scope of Security Robot

The diverse regional submarkets of the global security robot market include North America, Europe, Asia-Pacific, Latin America, the Middle East, and Africa. The global market for indoor robots is anticipated to grow at a CAGR of 25.50% between 2022 and 2029, from USD 11.65 billion in 2021 to USD 100.37 billion in 2029. The curation of market research by the Data Bridge Market Research team.



Thank You