

Progress Presentation-I

e-Yantra Summer Internship-2017
Modular Robots

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IIT, Bombay

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Overview of Project

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Overview of Project

Overview of Task

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Challenges Faced

Future Plans

Thank You

■ **Project Name:** Modular Robots

■ **Objective**

- 1 To build a Self-reconfigurable autonomous robot which can deliberately change shape by reorganizing connectivity between the modules.
- 2 To add sensors to the robot and make it smart.
(To sense and take action according to the environment)

■ **Deliverables**

- 1 A stable modular robot which is able to change its shape upon the need of the environment
- 2 Code and Documentation of each Task (1-6)

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Task No.	Task	Deadline
1	Getting Familiar with existing models of Modular Robots	2 days
2	Interfacing Arduino IDE with Servo, Blue-tooth and Sensor	3 days
3	Testing and selecting appropriate sensors to be added in the module	2 days
4	Make design changes in the modules for accommodating sensors.	4 days
5	Assembling all the selected parts. Four robotic modules need to be produced	4 days
6	Applying algorithm to check different types of motion (Wheel, Snake, Ladder)	7 days
7	Autonomous Obstacle Avoidance using sensor detection and self-reconfiguration	6 days
8	Code & Documentation	6 days

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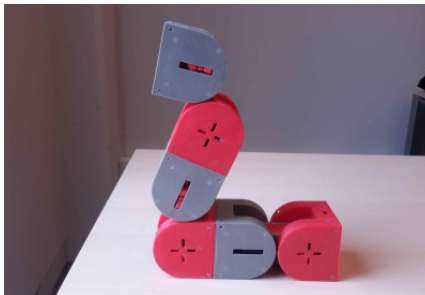
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Future Plans

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- **Task-1: Getting familiar with existing Modular Robots.**
 - Collected information on existing modular robots.
 - Prepared a report and concluded that the Dtto Modular Robot is the most promising option under the given time and resources.



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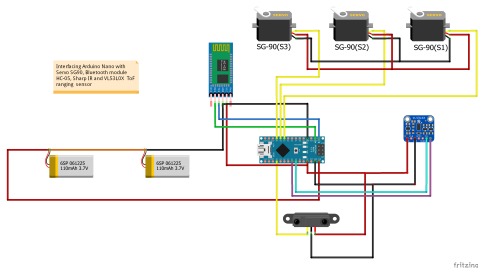
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- **Task-2 + 3: Selecting and interfacing sensors, servo motor and Bluetooth module with an Arduino.**
 - Successfully interfaced Bluetooth module HC-05 to HC-05 and HC-05 to PC/Android communication.
 - Interfaced servo motors and tested the Sharp IR sensor and VL53L0X ToF sensor for obstacle detection/distance measurement.



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■ Task-4: Making design changes in the modules.

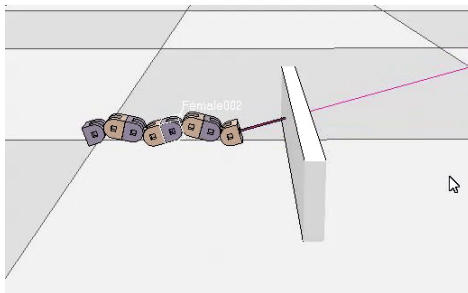
- No major design changes were required as the modules have space for the tiny VL53L0X distance measurement sensor.
- Holes for the screws had to be expanded due to unavailability of M1.7x4mm screws.



Task Accomplished

■ Simulations in V-REP

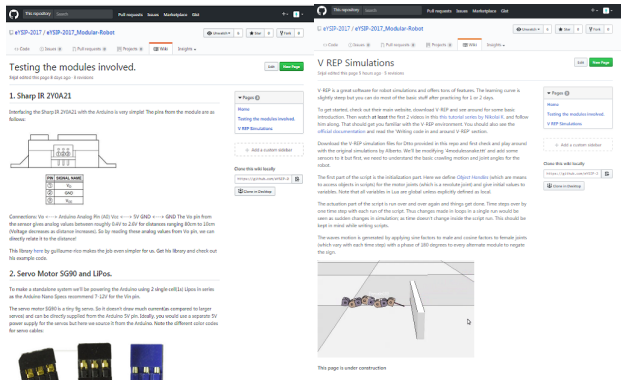
- Got familiar with the V-REP environment with Lua scripting and implemented practice simulations.
- Understood existing Dttto movements and modified design to add proximity sensor which can detect obstacles and also measure its height.
- Crossed the detected obstacles by reshaping modules in V-REP. See video.



Task Accomplished

■ Code and Documentation

- Uploaded well-commented code (Arduino + Simulations) on GitHub for every stage.
- Maintaining a detailed documentation of every step we take on GitHub Wiki of our repository.



Testing the modules involved.

1. **Sharp IR 2Y0A21**

Interfacing the Sharp IR 2Y0A21 with the Arduino is very simple! The pin from the module are as follows:

Pin	Signal Name
1	Vcc
2	GND
3	AO

Connections: Vcc → Arduino Analog Pin (AO) Vcc → 5V GND → GND The Vcc pin from the sensor gives analog values between roughly 0.6V to 2.0V for distances ranging from 10cm (Voltage decreases as distance increases). So by reading these analog values from Vcc pin, we can directly relate it to the distance.

This library here by guillaume-rico makes the job even simpler for us. Get his library and check out his example code.

2. **Servo Motor SG90 and LiPos.**

To make a standalone system out of it by powering the Arduino using 2 single cell LiPos in series as the Arduino Nano Specs recommend 7-12V for the Vcc pin.

The servo motor SG90 is a tiny by servo. So it doesn't draw much current as compared to larger servos and can be directly supplied from the Arduino 5V pin. Ideally, you would use a separate 5V power supply for the servos but here we source it from the Arduino. Note the different color codes for servo cables.

V REP Simulations

V-REP is a great software for robot simulations and offers tons of features. The learning curve is slightly steep but you can do most of the basic stuff after practicing for 1 or 2 days.

To get started, check out their main website, download V-REP and set it up. For some basic introduction, then watch at least the first 2 videos in this tutorial series by Nikhil K. and follow him along. That should get you familiar with the V-REP environment. You should also see the official documentation and read the Writing code in and around V-REP section.

Download the V-REP simulation files for C++ provided in this repo and first check and play around with the original simulations by Alberto. We'll be modifying 'AmodeusRobot1' and add some sensors to it but first, we need to understand the basic crawling motion and joint angles for the robot.

The first part of the script is the initialization part. Here we define **Object Handles** (which means to access objects in script) for the motor joints (which is a revolute joint) and give initial values to variables. Note that all variables in Lua are global unless explicitly defined as local.

The activation part of the script is run over and over again and things get done. These steps over by one time step with each run of the script. These changes made in logic in a single run would be seen as sudden changes in simulation as time doesn't change inside the script run. This should be kept in mind while writing scripts.

The sensor module is generated by applying one factor to make and control factors to handle joint, which vary with each time step with a phase of 360 degrees to every alternate module to regulate the signs.

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- Appropriate screws (M1.7x4mm Flathead) were unavailable, so the CAD design was modified multiple times and the printing and assembling of modules has been delayed.
- The specified Servo motor, MG92B is unavailable in local and online stores so we're forced to use a lower torque motor MG90S, which is the closest that can be fit under the given module dimensions.

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- All printed parts assembled. Four Robotic modules to be assembled.
- Develop effective and generalized algorithms for different motions.
- Obstacle detection using sensors and decision making to avoid/overcome the obstacle while robot moves from one point to another.

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