

NOMAD ROVER

PREPARED BY

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OUTLINE

- **Project Definition**
- **Project Objectives**
- **Project Specifications**
- **Project Background**
- **Design**
 - **Constraints**
 - **Goals**
 - **Components**
 - **Alternatives**
- **Testing**
- **Challenges Faced**
- **Management Plan**

PROJECT DEFINITION

To design a vehicle that can carry out tasks in environments that are inaccessible or unsafe. The tank will be equipped with a hand to perform various operations at a higher level of precision and accuracy.



PROJECT OBJECTIVES

- Able to handle various terrains and small obstacles
- Easy control with video feed.
- A robotic arm that can follow the accuracy and precision of human hand.



PROJECT SPECIFICATION

- 2 DOF Mechanical hand that will be remotely controlled using hand gestures
- Robust vehicle chassis able to handle everyday abuse
- Can be controlled using a wireless controller
- Equipped with camera for video navigation



BACKGROUND : **PROBLEM**

SPACE EXPLORATION

- AS OF 2016, 18 ASTRONAUT AND COSMONAUT FATALITIES HAVE BEEN RECORDED RELATED TO SPACE EXPLORATION
- ASTRONAUTS ARE AT HIGH RISKS IN OUTER SPACE WITH LIMITED RESOURCES
- WITH ASTRONAUTS SPACE EXPLORATIONS ARE LIMITED TO PLANETS THAT ARE CLOSER TO EARTH



BACKGROUND : **PROBLEM**

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MILITARY SECTOR

- SCOUTING UNKNOWN LOCATIONS IS DANGEROUS AND HAS PUT A SOLDIER'S LIFE IN DANGER
- COMBATS WITH POISONOUS GASES AND LIKEWISE ARE BEYOND HUMAN SENSES TO IDENTIFY, AND HAS TAKEN A LOT OF LIVES
- RISKY SITUATIONS LIKE BOMB DISPOSAL OPERATIONS HAVE A HIGH FAILURE RATE THAT HAD COST LIVES IN THE PAST



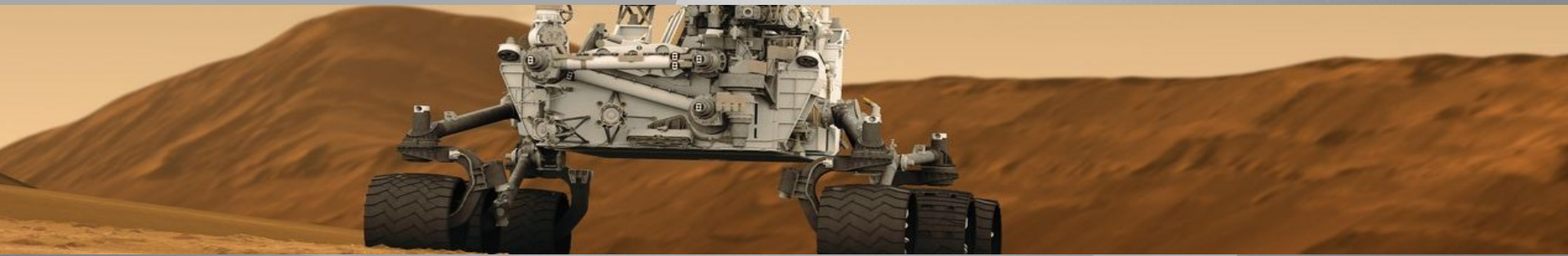
BACKGROUND : DESIGN

- REMOTELY CONTROLLED BY OPERATOR
- CAPABLE OF TRAVELLING ON UNEVEN OR ROUGH GROUNDS
- SHOULD BE ABLE TO COLLECT AND RECORD DATA ON FIELD
- CAN TRANSFER DATA TO OPERATOR REMOTELY

BACKGROUND : **ADVANTAGES**

SPACE EXPLORATION

- CAN SAFELY SCOUT AND EXPLORE UNKNOWN REGIONS
- LIMITED RESOURCES REQUIRED COMPARED TO HUMANS
- DOESN'T HAVE TO BE RETURNED TO EARTH AFTER A MISSION
- THE ARM CAN BE USED TO ASSIST ASTRONAUTS OR CARRY OUT SMALL OPERATIONS





MILITARY SECTOR

- CAN SAFELY SCOUT AND ANALYZE SUSPECTED REGIONS
- CAN TRANSPORT IMMEDIATE SUPPLIES BETWEEN HOTSPOTS
- CAN CARRY OUT SMALL OPERATIONS WITH EASY CONTROL USING THE ARM



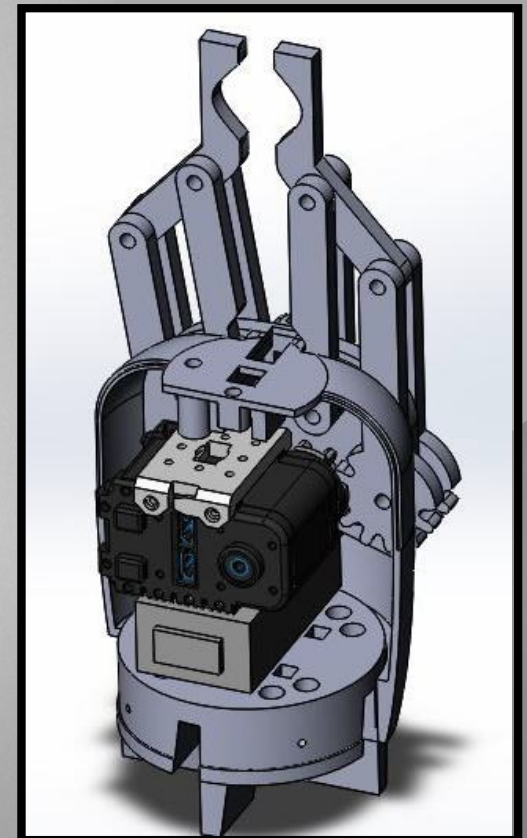


PREVIOUS PROJECTS 1

Gripper Design For A Modular Robot, Anna Maria Gil Fuster, Technical University Of Denmark, June 2015

FEATURES

- Claw style grip capable of grasping small objects
- 3D Printed claws to hold different shapes
- IR sensor to detect object and determine the torque

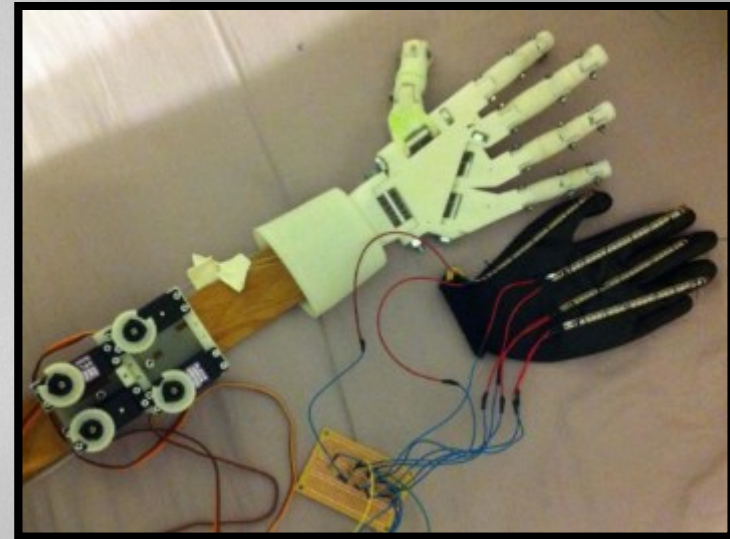


PREVIOUS PROJECTS 2

SENSOR CONTROLLED ROBOTIC HAND, *Law Chor Hon, The University Of Hong Kong, January 2016*

FEATURES

- 3D printed five finger hand/arm system
- Controlled using hand gestures
- Provides haptic feedback when grabbing objects



PREVIOUS PROJECTS 3

Oregon State Mars Rover, Jesse A. Grimes, Jesse A. Grimes, July 2011

FEATURES

- 6 wheel balloon tires with a motor for each wheel
- High ground clearance for off road driving
- Wireless video transmission
- Robotic arm structure with camera assistance



PREVIOUS PROJECTS 4

A Prototype Of Mars Exploration And Research Rover, Vishnu D. S, SCT College of Engineering, MARCH 2014

FEATURES

- THREE WHEELS WITH TWO MOTORS
- ATMOSPHERIC SENSOR
- PROXIMITY SENSOR
- SOLAR POWERED
- AUTOMATED CONTROL



PREVIOUS PROJECTS SUMMARY

FEATURES	PR 1	PR 2	PR 3	PR 4	EXP
5 FINGER ROBOTIC HAND	x	✓	x	x	✓
2 DOF ARM	x	✓	✓	x	✓
PRECISION CONTROL OF ARM	✓	✓	x	x	✓
LIVE VIDEO FEED	✓	x	✓	x	✓
CAR BASE	x	x	✓	✓	✓
CAPABLE OF COVERING DIFFERENT TERRAINS	x	x	✓	✓	✓
METALLIC COMPONENTS FOR CAR	x	x	✓	✓	✓
SENSORS FOR SURROUNDING	x	x	✓	✓	✓
REMOTE CONTROL	x	x	✓	x	✓

DESIGN CONSTRAINTS

ENGINEERING STANDARDS

- ▶ COMPLYING TO VARIOUS STANDARDS IN COMMUNICATION AND COMPONENTS ASPECTS

ENVIROMENT-FRIENDLY

- ▶ RECYCLABLE MATERIALS
- ▶ EFFICIENT POWER CONSUMPTION WITHOUT WASTEAGE

DESIGN CONSTRAINTS

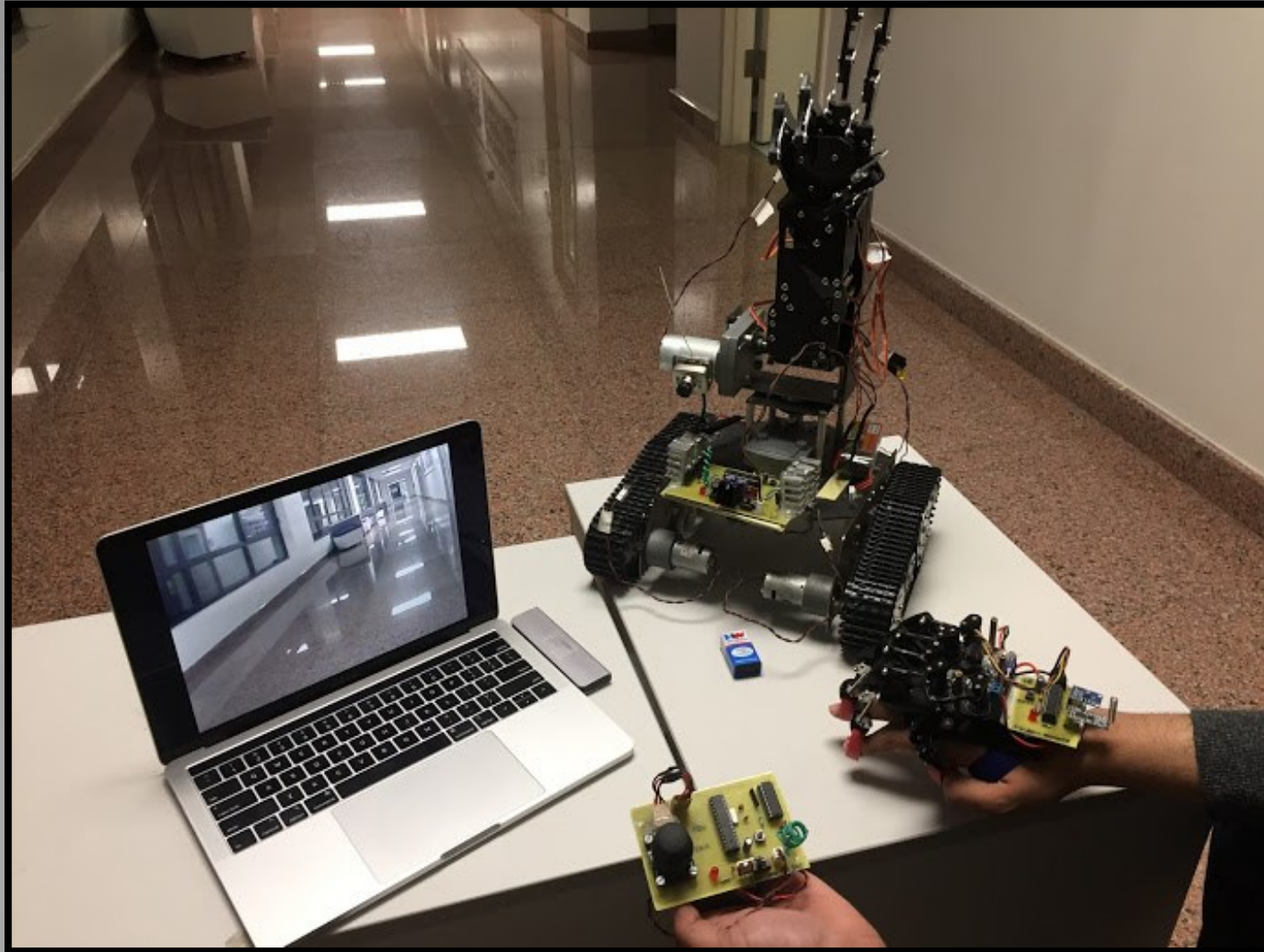
SAFETY

- ▶ CAPACITORS AND INDUCTORS TO PROTECT CIRCUITS AND OTHER COMPONENTS FROM OVER VOLTAGES AND CURRENTS
- ▶ INSULATING COMPONENTS INTERACTING WITH THE USER

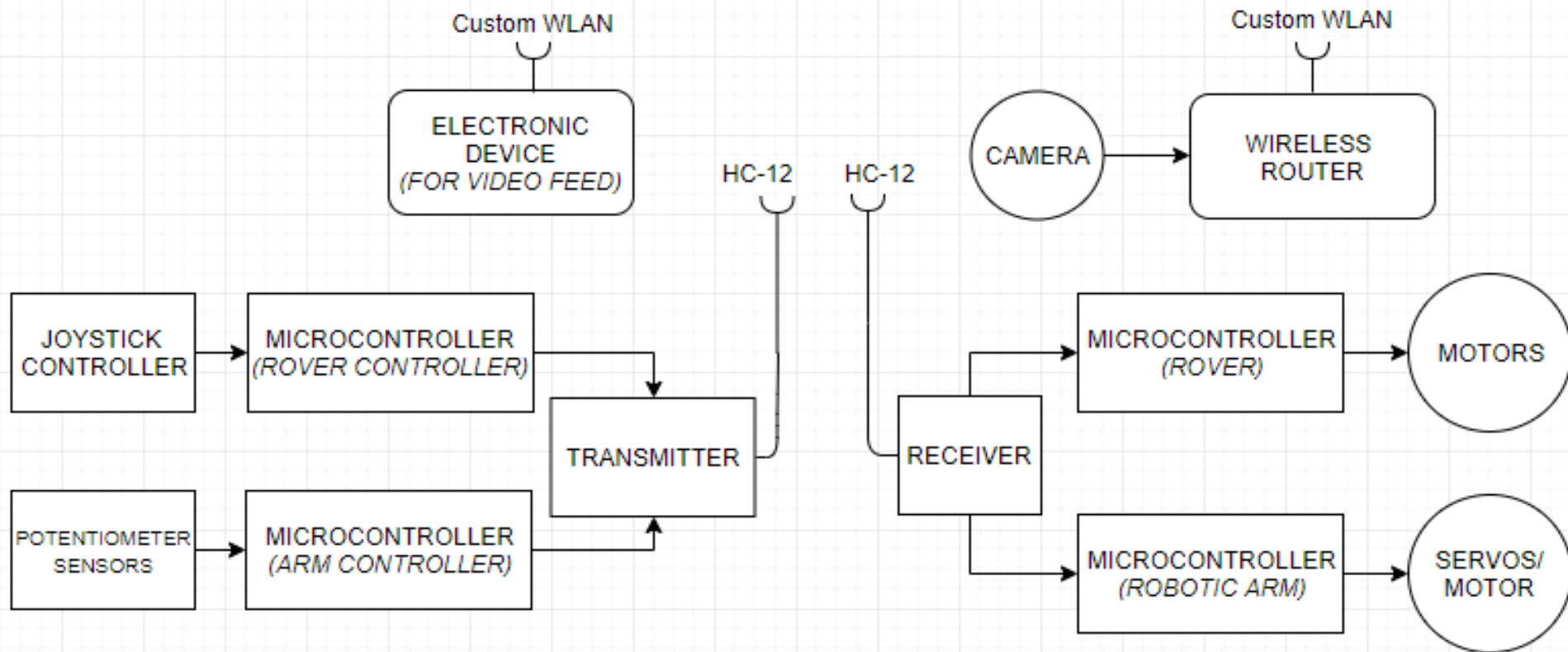
BUDGET

- ▶ CAREFUL PLANNING OF BUDGET SPENT
- ▶ PRE-ORDERING COMPONENTS AND ANALYZING THEIR QUALITY BEFORE PURCHASE

PROJECT PROTOTYPE



PROJECT ARCHITECTURE FOR NOMAD ROVER



DESIGN

- ▶ ROVER BASE

 - ▶ BASE

 - ▶ CONTROLLER

- ▶ ROBOTIC HAND

 - ▶ ROBOTIC ARM

 - ▶ ROBOTIC HAND CONTROLLER

DESIGN GOALS

▶ ROVER BASE

- ▶ Can be remotely controlled
- ▶ Can support the weight of the hand

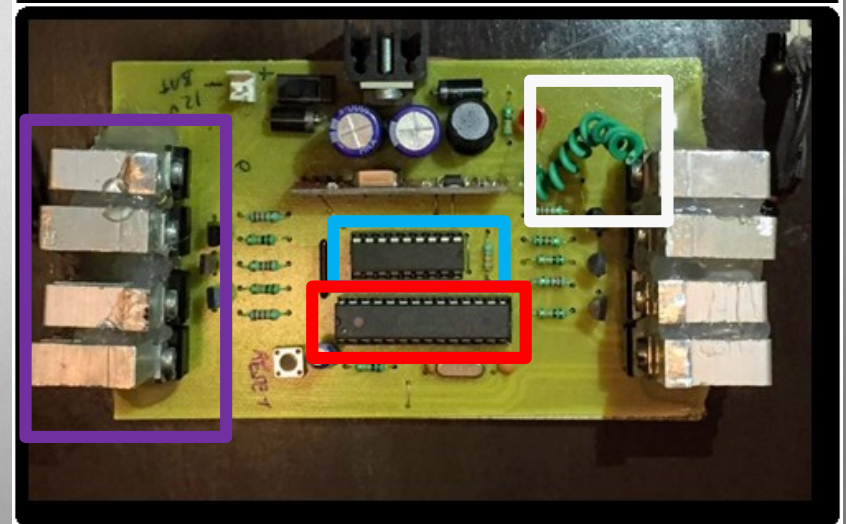
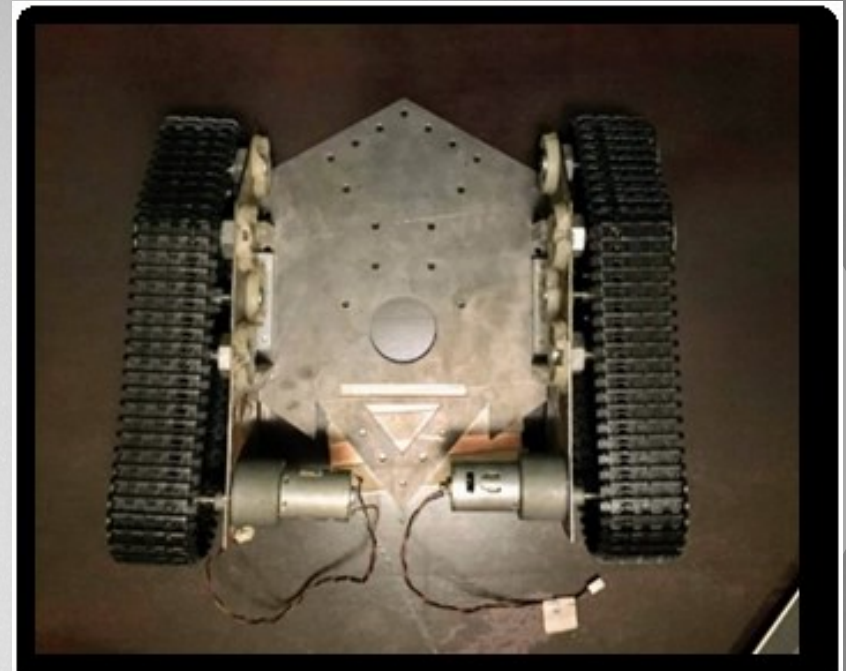
▶ ROBOTIC HAND

- ▶ Can be remotely controlled
- ▶ Can follow and imitate human hand gestures and movements

ROVER BASE

BASE (RECEIVER)

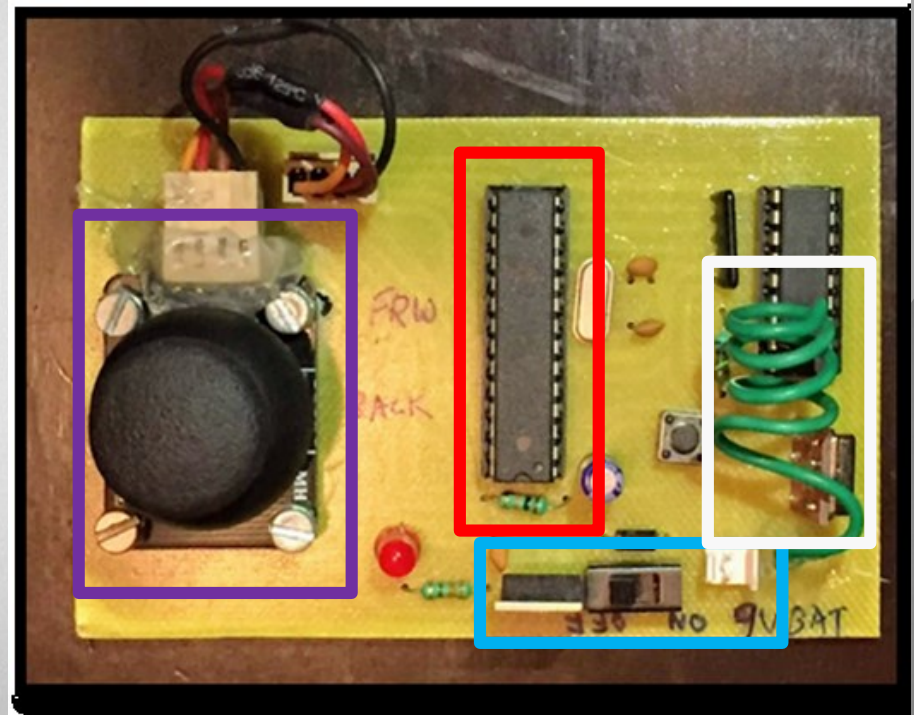
- ▶ STAINLESS STEEL CHASSIS
- ▶ 10 KG LOAD CAPACITY
- ▶ TWIN 12V DC MOTORS
- ▶ TANK TRACKS
- ▶ ATMEL POWERED
- ▶ HC12 CONNECTION PROTOCOL



ROVER BASE

ROVER CONTROLLER

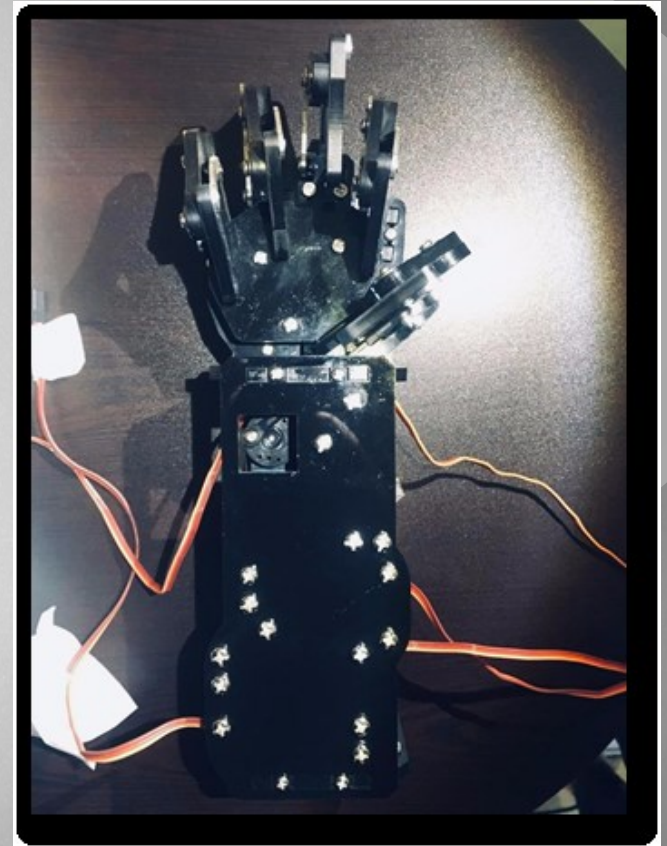
- ▶ ATMEL BASED ARCHITECTURE
- ▶ JOYSTICK CONTROL
- ▶ 9V BATTERY POWERED
- ▶ HC12 CONNECTION PROTOCOL



ROBOTIC HAND

ROBOTIC ARM

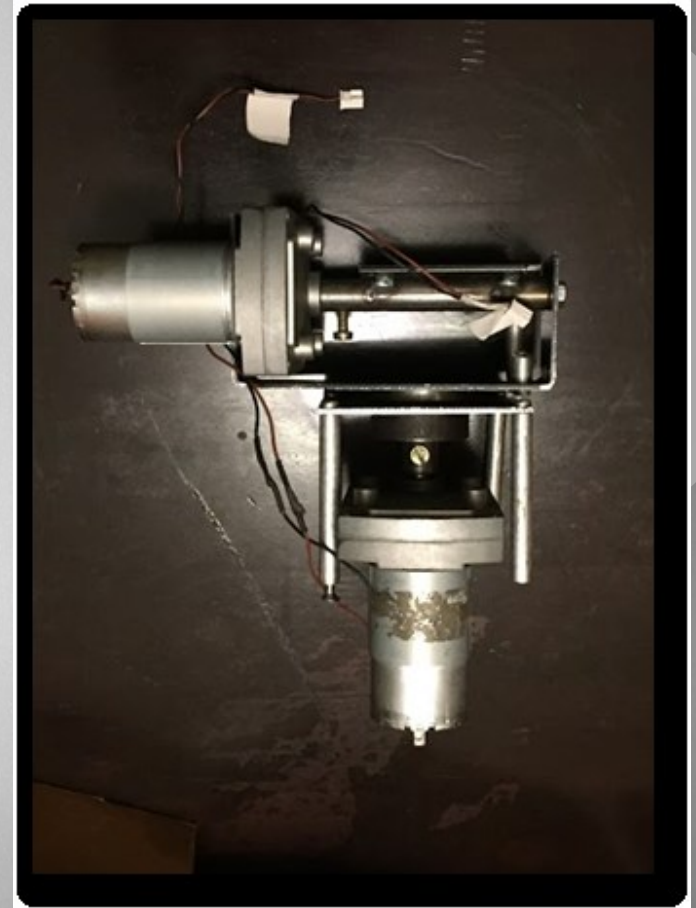
- ▶ SERVOS FOR EACH FINGER
- ▶ LOOKS LIKE A HUMAN HAND



ROBOTIC HAND

ROBOTIC ARM

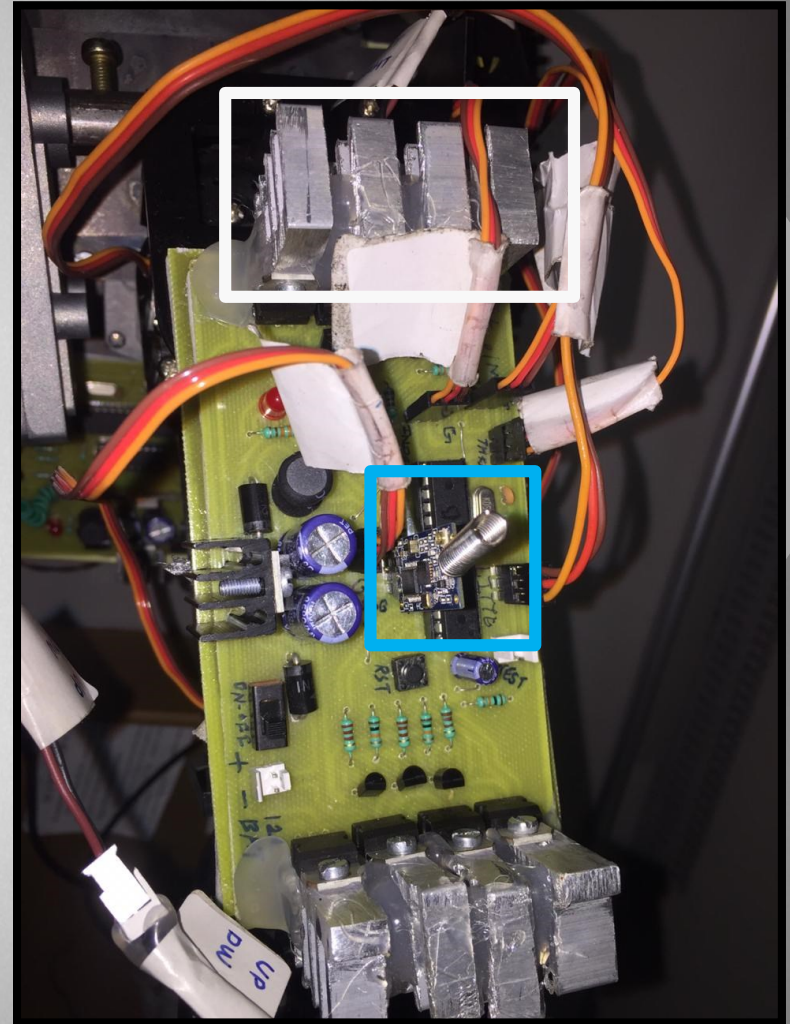
- ▶ ITS BETWEEN THE HAND AND THE BASE
- ▶ HIGH TORQUE DC MOTORS
- ▶ ENABLES 2 DOF FOR ROBOTIC ARM



ROBOTIC HAND

ROBOTIC ARM

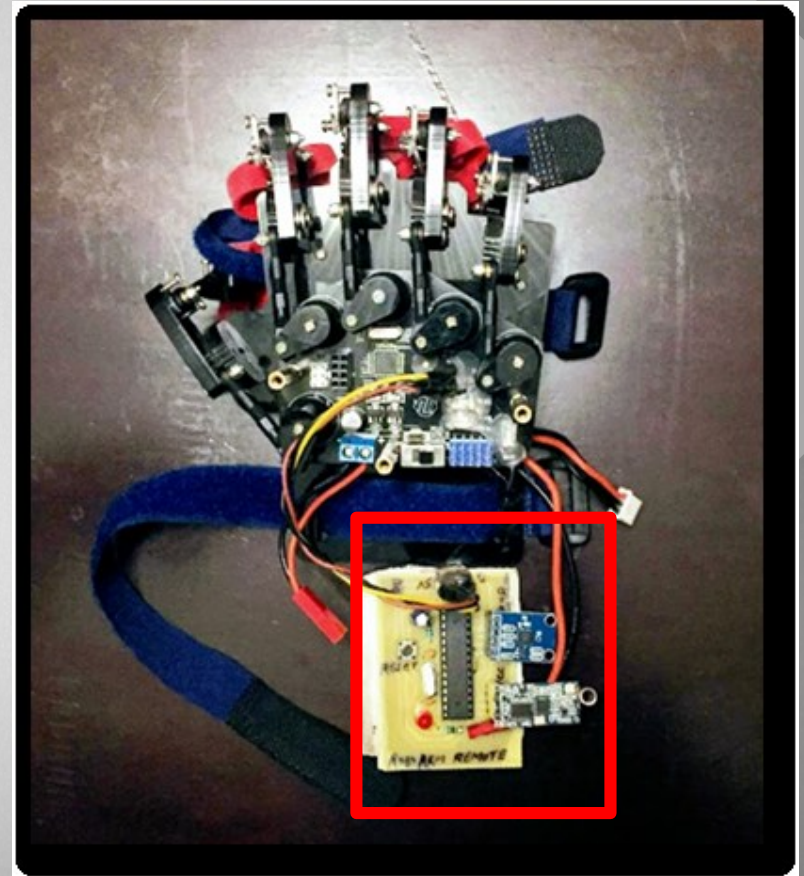
- ▶ ATMEL BASED ARCHITECTURE
- ▶ HC12 CONNECTION PROTOCOL



ROBOTIC HAND

ROBOTIC ARM CONTROLLER

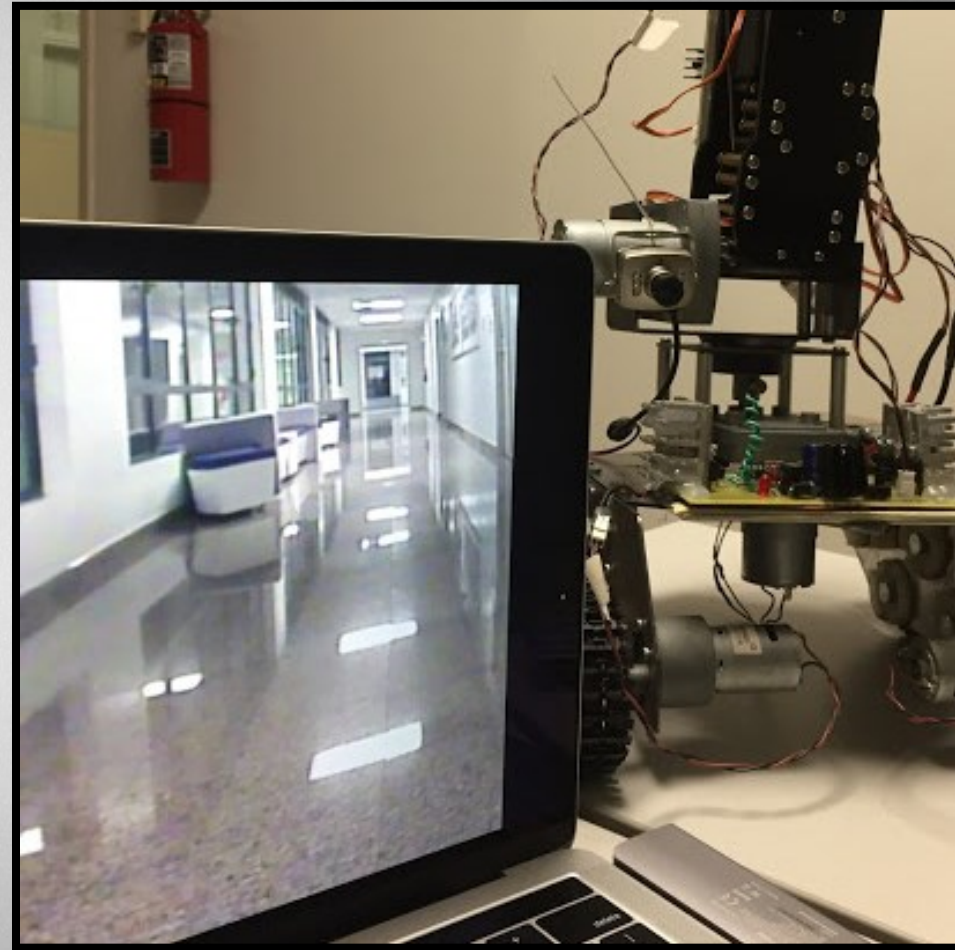
- ▶ INDIVIDUAL FINGER CONTROL
(USING POTENTIOMETERS)
- ▶ MOTION BASED ARM CONTROL
- ▶ ATMEL BASED ARCHITECTURE
- ▶ HC12 CONNECTION PROTOCOL



ROBOTIC HAND

CAMERA

- ▶ LIVE VIDEO FEED
- ▶ EASY CONNECTION
- ▶ MOVES WITH ARM
- ▶ STREAMS ON PC
- ▶ 9V BATTERY POWERED



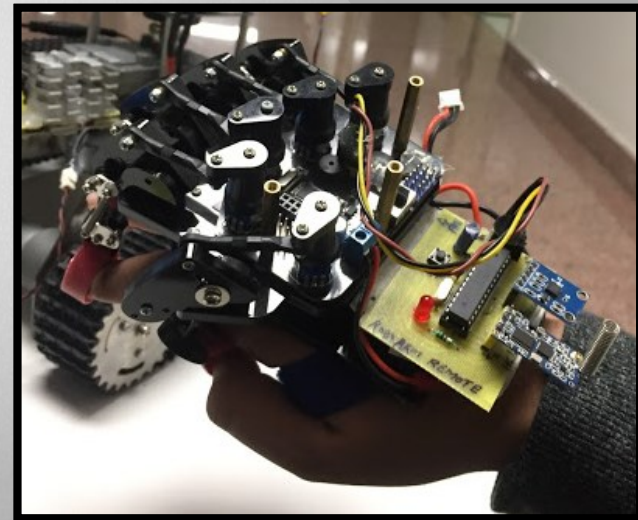
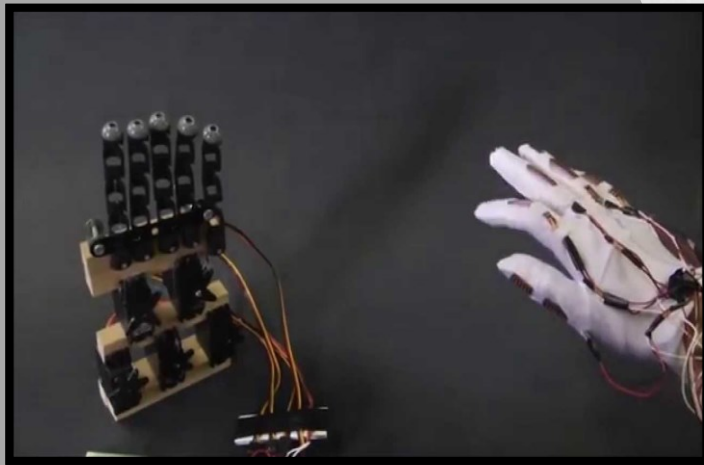
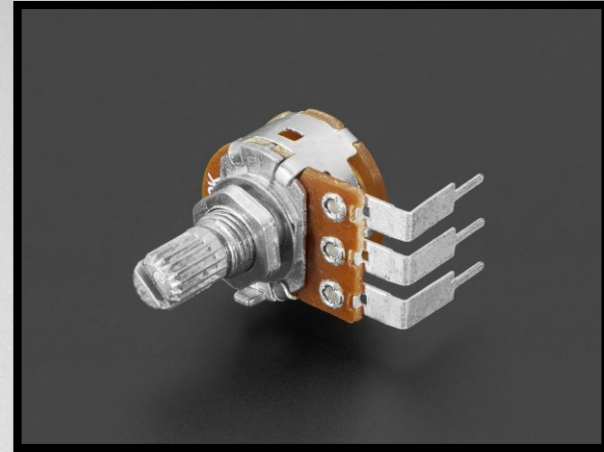
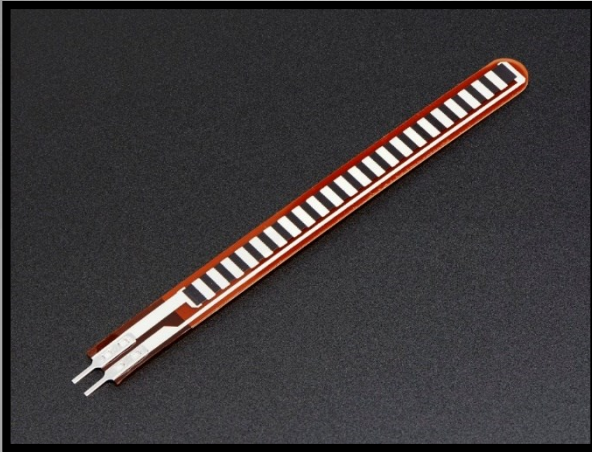
DESIGN CHOOSING ALTERNATIVES

- ▶ **SENSORS (ROBOTIC ARM CONTROLLER)**
- ▶ **CAMERA**
- ▶ **COMMUNICATION**
- ▶ **CIRCUITRY**

DESIGN SENSORS

<i>Feature</i>	<i>Flex Sensors</i>	<i>Potentiometer</i>
CODING	Complex	Simple
SENSITIVITY	High	Medium
DESIGN	Not User Friendly	User Friendly

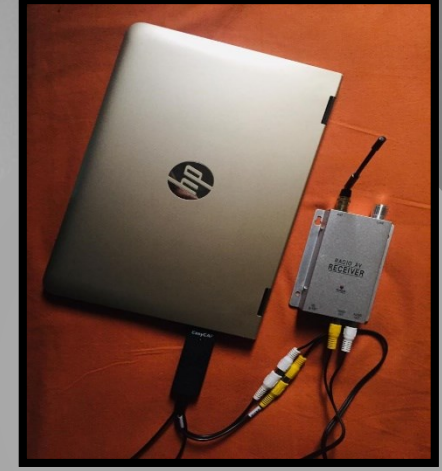
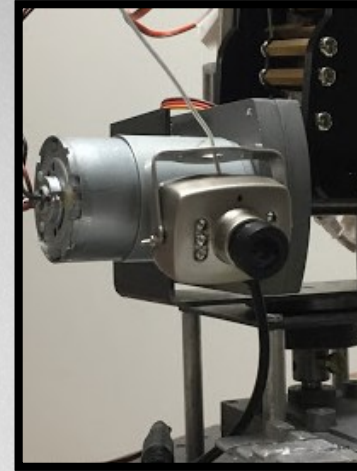
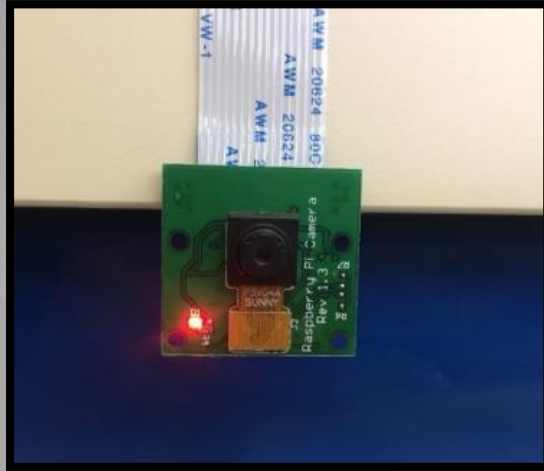
DESIGN SENSORS



DESIGN CAMERA

<i>Feature</i>	<i>Raspbery (RaspiCam)</i>	<i>Generic infrared camera</i>
CODING	Complex	In Built
QUALITY	480p	720p
NIGHT VISION	No	Yes
DELAY	5 sec	0.5 sec
RANGE	Long Range	Short Range

DESIGN CAMERA

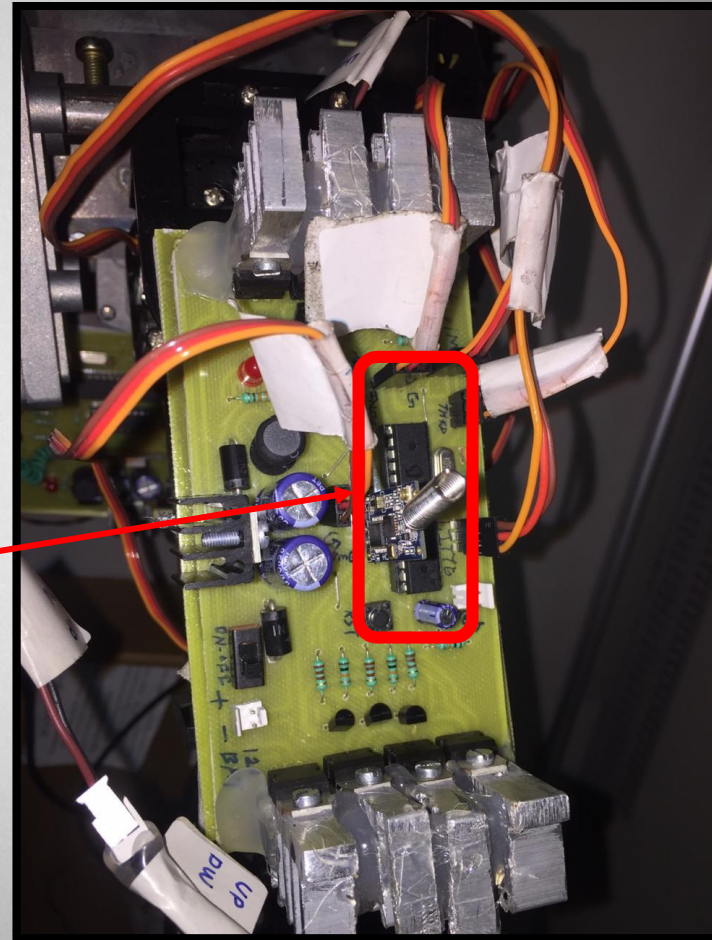
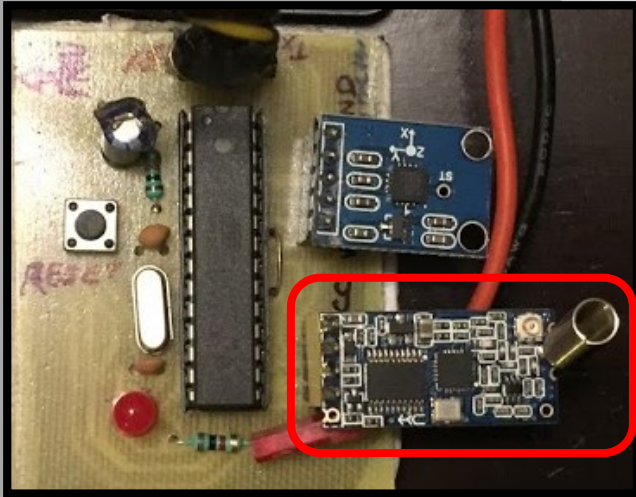


DESIGN COMMUNICATION

<i>Feature</i>	<i>XBee</i>	<i>Bluetooth</i>	<i>HC12</i>
RANGE	1.2 KM	100 M	1 KM
PROGRAMMING	XCTU	Arduino IDE	Arduino IDE
MODES	Two way	One Way (Receiver)	Two way
PAIRING	Requires setup	Easy pairing	Easy Pairing

DESIGN COMMUNICATION

ROBOTIC ARM CONTROLLER

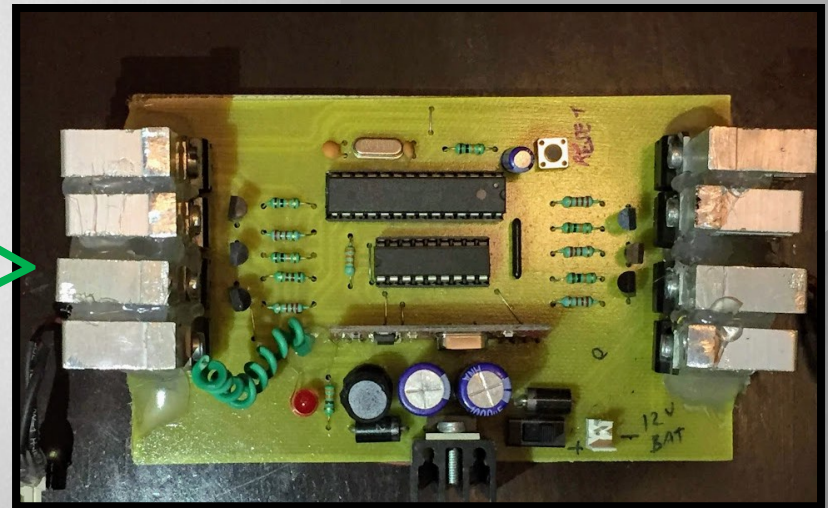
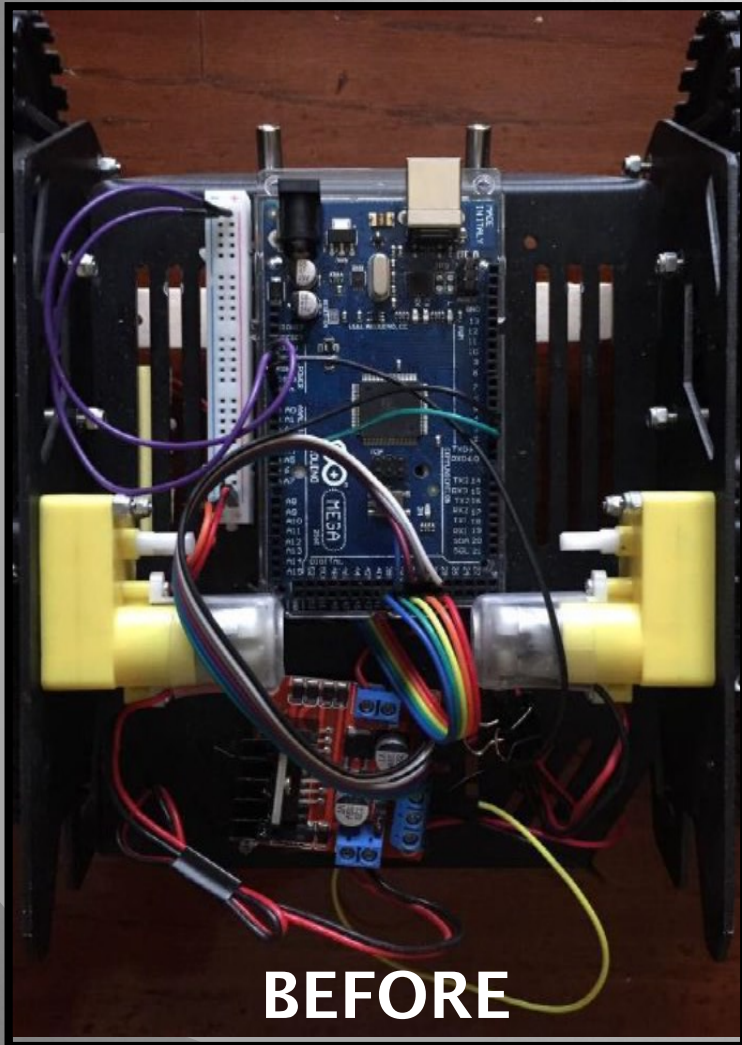


ROBOTIC ARM

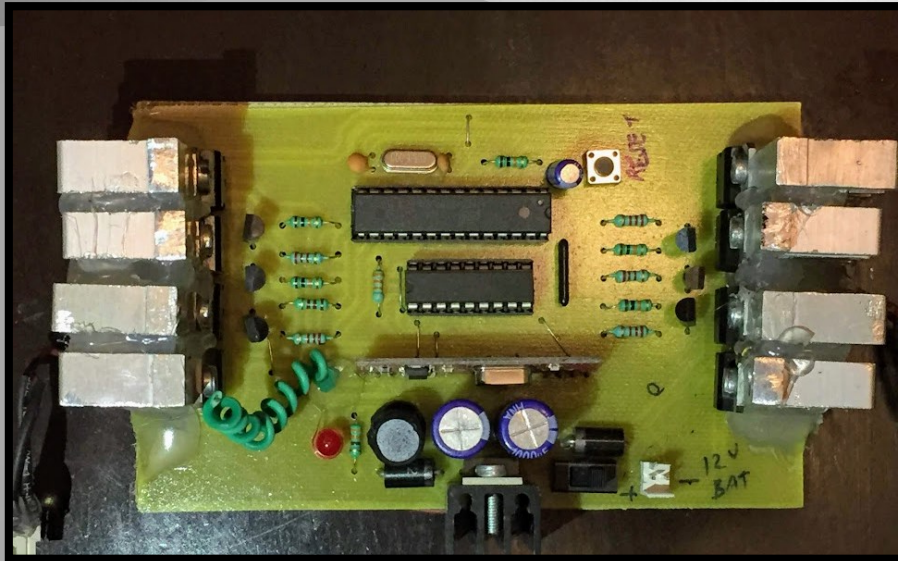
DESIGN CIRCUITRY

<i>Feature</i>	<i>Breadboards</i>	<i>PCB</i>
JUMPERS	YES	NO
STABLE CONNECTIONS	NO	YES (soldered)
SPACE	Occupies more space	Less space required

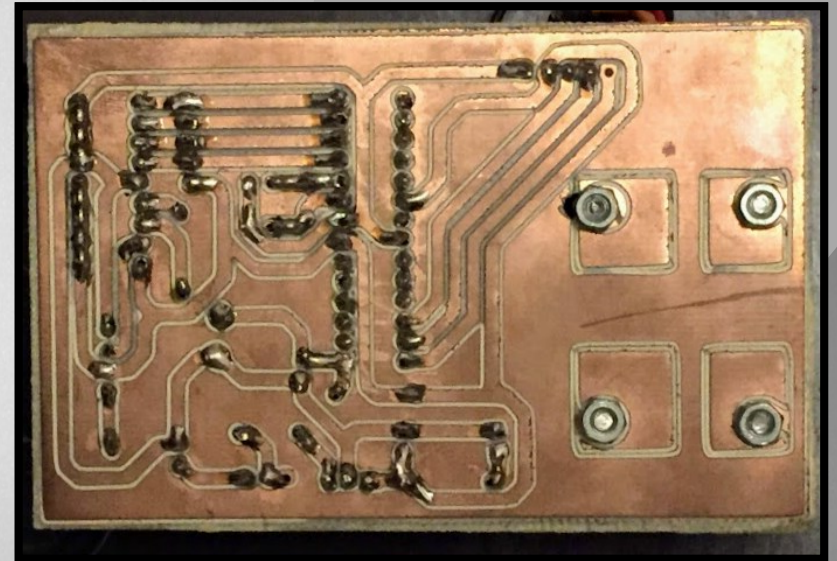
DESIGN CIRCUITRY



DESIGN CIRCUITRY

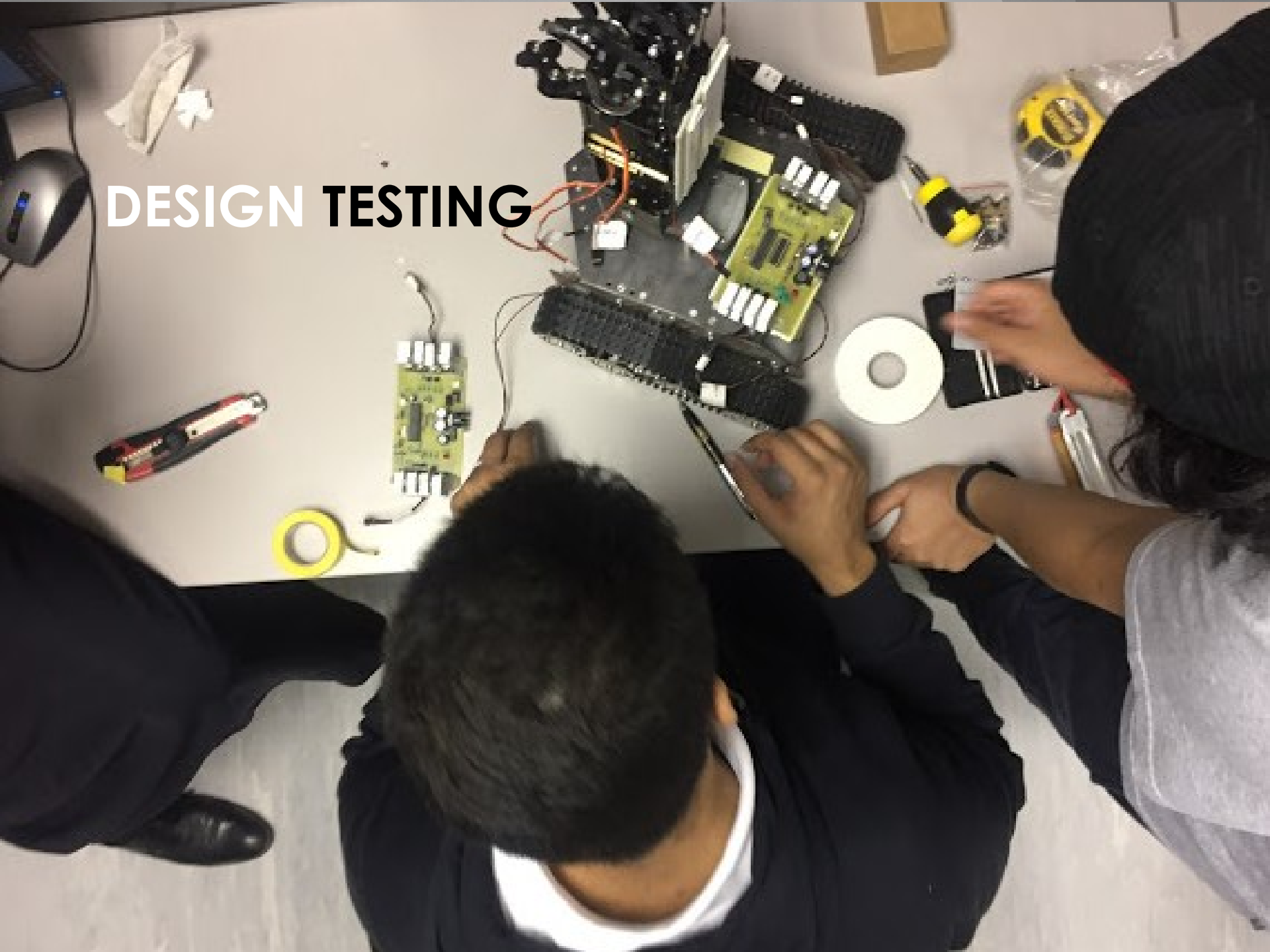


FRONT



REAR

DESIGN TESTING



TESTING COMMUNICATION

COMPONENT	RESULTS	LOCATION
ROBOTIC HAND	Solid Connection indoors (tested 300m)	Indoors
	Solid Connection outdoors (tested 500m)	Outdoors
ROVER	Solid Connection indoors (tested 25m)	Indoors
	Solid Connection outdoors (tested 25m)	Outdoors

TESTING CAMERA

COMPONENT	PARAMETER	RESULTS
ROBOTIC HAND	Range	Indoors: 20 M Outdoors: 30 M
	Night vision	Functioning infrared vision in the dark
	Pairing Process	Instant pairing when turned on and in range

TESTING ROBOTIC HAND

COMPONENT	PARAMETER	RESULTS
PARAMETER	PRECISION	FINGER TO FINGER ACCURACY
	ARM MOVEMENT	ACCURATE POSITION TRACKING
	DELAYS	0.5 SEC ARM MOVEMENTS 0.2 SEC FINGER TRACKING

TESTING BATTERY

SUBSYSTEM	COMPONENT	RESULTS
ROBOTIC HAND	CONTROLLER (Inbuilt Rechargeable 9V DC)	30 min
	RECEIVER (11.1V LiPo Battery)	30 min
	CAMERA (9V DC Battery)	30 min
ROVER	RECEIVER (11.1V LiPo Battery)	15 min
	CONTROLLER (9V DC Battery)	30 min

CHALLENGES

- ▶ CAMERA

Generic Camera has short range

- ▶ COMMUNICATION

HC12 FOR ROVER REPLACED WITH RF

- ▶ COMPONENT AVAILABILITY

Faulty components were difficult to replace

- ▶ BATTERY

Short Battery life

The background features a light gray gradient with several overlapping circles of varying sizes and shades of gray. A vertical gray bar is positioned in the upper right corner.

MANAGEMENT PLANS

DESIGN PROGRESS

SN	TASKS & RESPONSIBILITIES		SEMESTER WEEKS															
			1	2	3	4	5	6	7	8	9	10	11	12	13	14		
1	DESIGN SUBSYSTEM SS1 (ROBOTIC HAND)	ALL	100%															
2	IMPLEMENT DESIGN FOR SS1	SM,AK			100%													
3	TEST AND REFINE DESIGN FOR SS1	FF, MS					100%											
4	DESIGN SUBSYSTEM SS2 (HAND CONTROLLER)	ALL	100%															
6	IMPLEMENT DESIGN FOR SS2	SM,AK			100%													
7	TEST AND REFINE DESIGN FOR SS2	FF, MS								100%								
8	INTEGRATE SUBSYSTEMS SS1 & SS2	ALL										100%						
9	WRITE PROGRESS REPORTS (WEEKLY)	ALL	100%					100%		100%		100%						
10	PREPARE PRESENTATIONS	ALL		100%														
11	PREPARE DEMO. (PROTOTYPE)	ALL									100%							
12	PREPARE FINAL REPORT	ALL			100%													

PLANNING

TASK	STATUS
INITIATION (TOPIC, TEAM MEMBERS, ADVISOR)	COMPLETED
DESIGN RESEARCH (SCHEMATICS, OBJECTIVES)	COMPLETED
PRODUCT RESEARCH (ALTERNATIVES, SCOPE, APPLIC.)	COMPLETED
FEASIBILITY RESEARCH (PARTS, BUILDING, DESIGNS)	COMPLETED
BUILDING PLAN (ASSEMBLING, TESTING, REPORTS)	COMPLETED
ASSEMBLING	COMPLETED
TROUBLESHOOTING	COMPLETED
TESTING	COMPLETED
IMPROVEMENTS	COMPLETED
FINAL PROTOTYPE	COMPLETED