Prince Mohammad Bin Fahd University
College of Engineering
Department of Electrical Engineering

Wall Climbing Robot (WCR)

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Project Definition

To design and fabricate a wall climbing robot that can move vertical and horizontal on wall and surfaces in industrial buildings, confined spaces and risky environment.

The robot can do the following:

1. Detecting gases
2. Temperature sensing
3. Video streaming

Project Objectives

- To design a wall climbing robot for cleaning, gas detection, video streaming, temperature sensing, general inspection and on high walls
- To fabricate a chassis, a body and adsorbing techniques by using different types of material and component
- To test the performance of the wall climbing robot on different surfaces and walls
- To reduce inspection cost, the robot weight and design cost
- To reduce number of deaths at work.

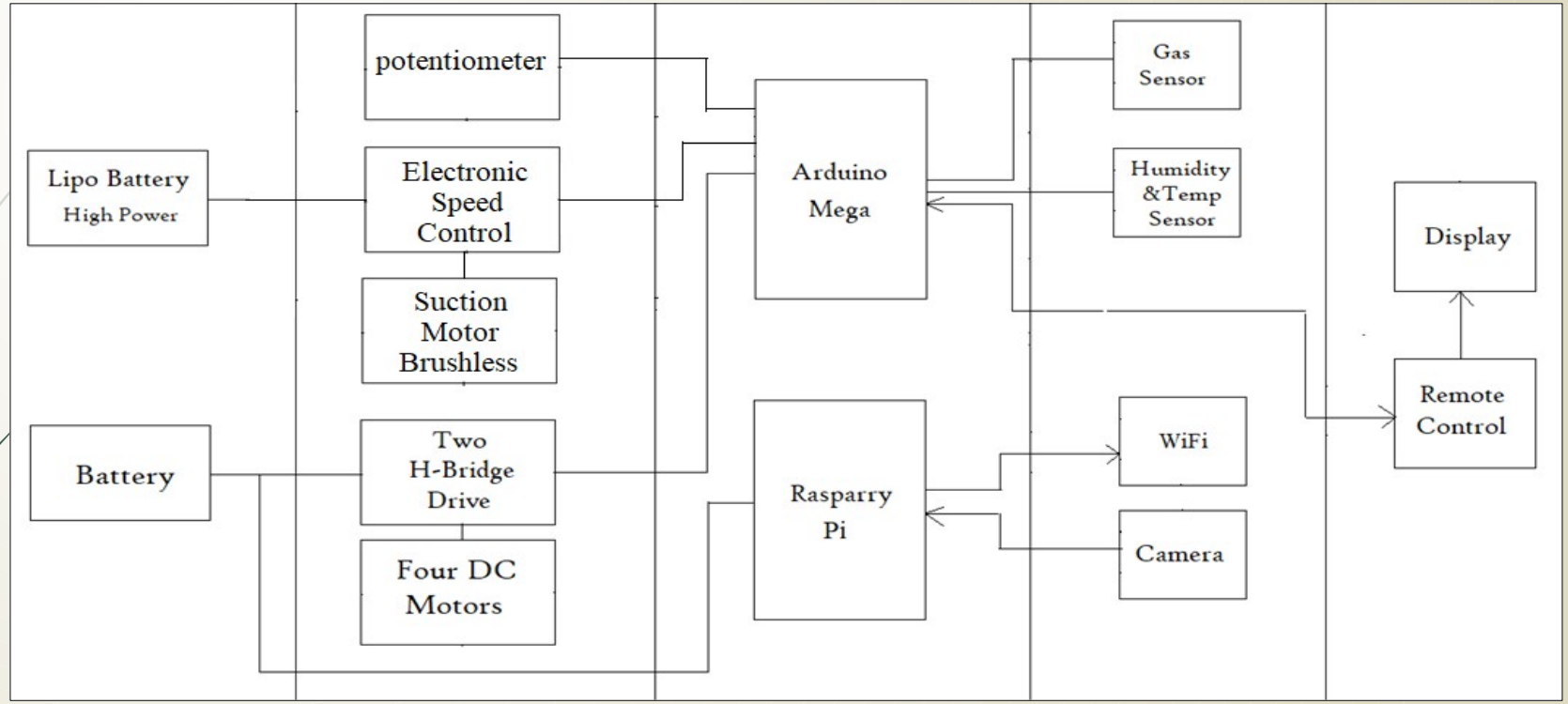
Project Specifications

- Robotic vehicle can vertically climb a glass and/or concrete wall.
- Remotely controlled using a mobile phone by Bluetooth.
- Equipped with a camera for video streaming using a WIFI internet.
- Equipped with sensors for monitoring with warning system of temperature, humidity, and gas.
- Can operate for a minimum of 10 to 15 minutes duration based on battery capacity (optional).

Design Constraints & Standards

1. Environmental
2. Safety and Health
3. Ethical
4. Manufacturability
5. Engineering standards
6. Costing

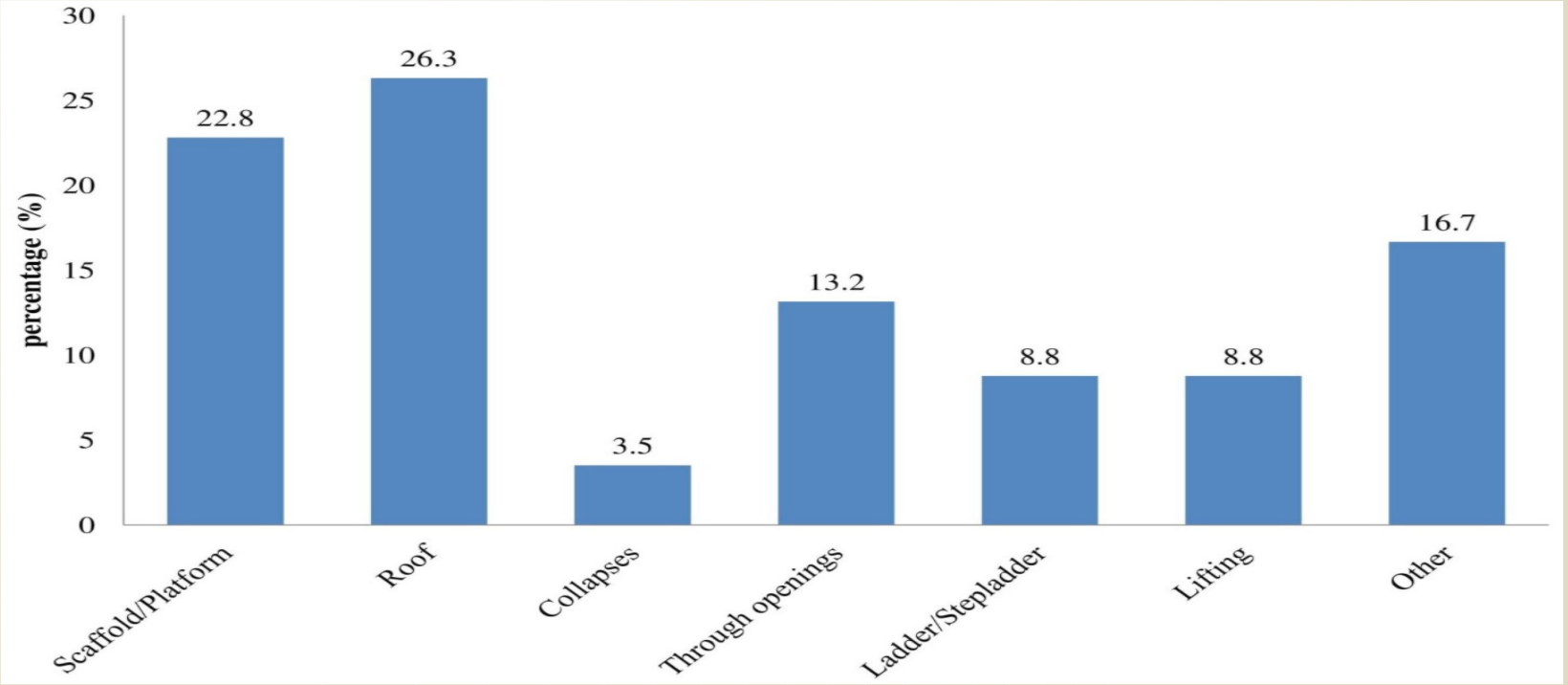
Project Architecture



Block Diagram

Background: Problem

- The high cost of qualified and trained inspector
- Take notes, pictures and video is difficult in confined spaces
- The impact of COVID-19 pandemic
- The impact of working at heights



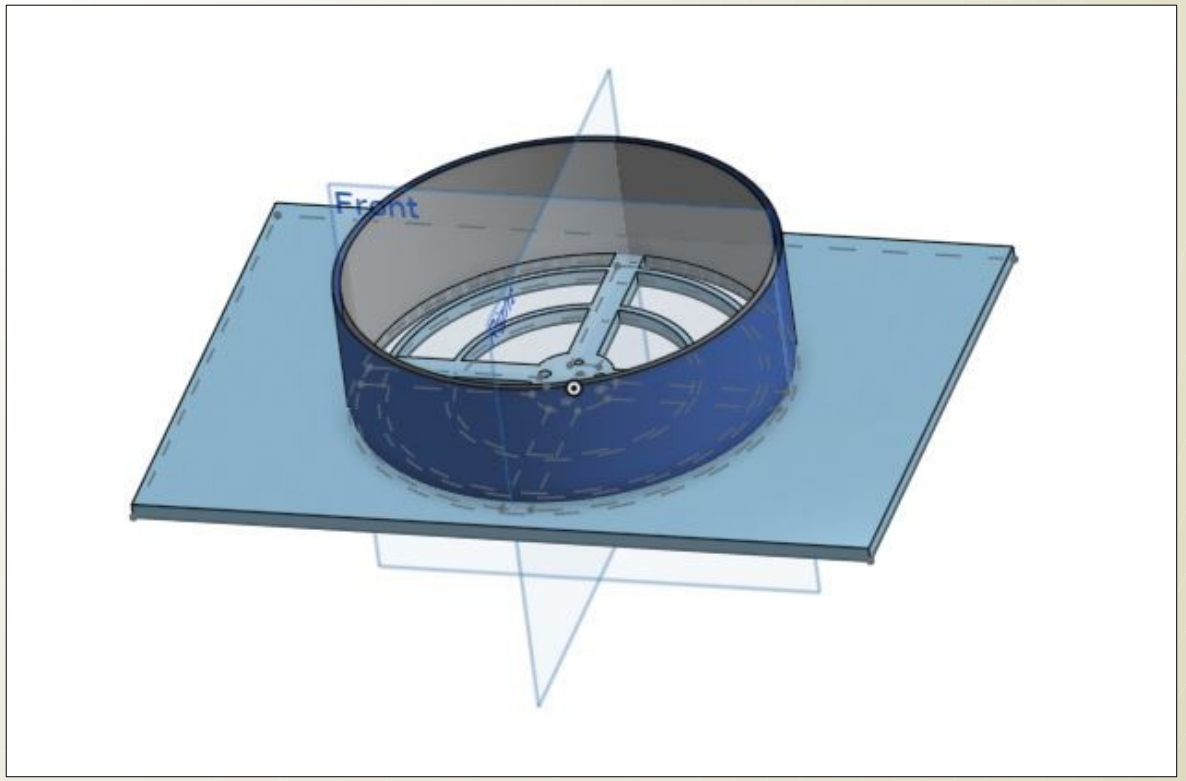
Background: Solutions

- The wall climbing robots can be used in many application such as non destructive evaluation, welding, construction, cleaning, and maintenance of high buildings.
- The wall climbing robot can be used for inspection, firefighting, detect damaged areas and detect gases.

Background: System Advantages

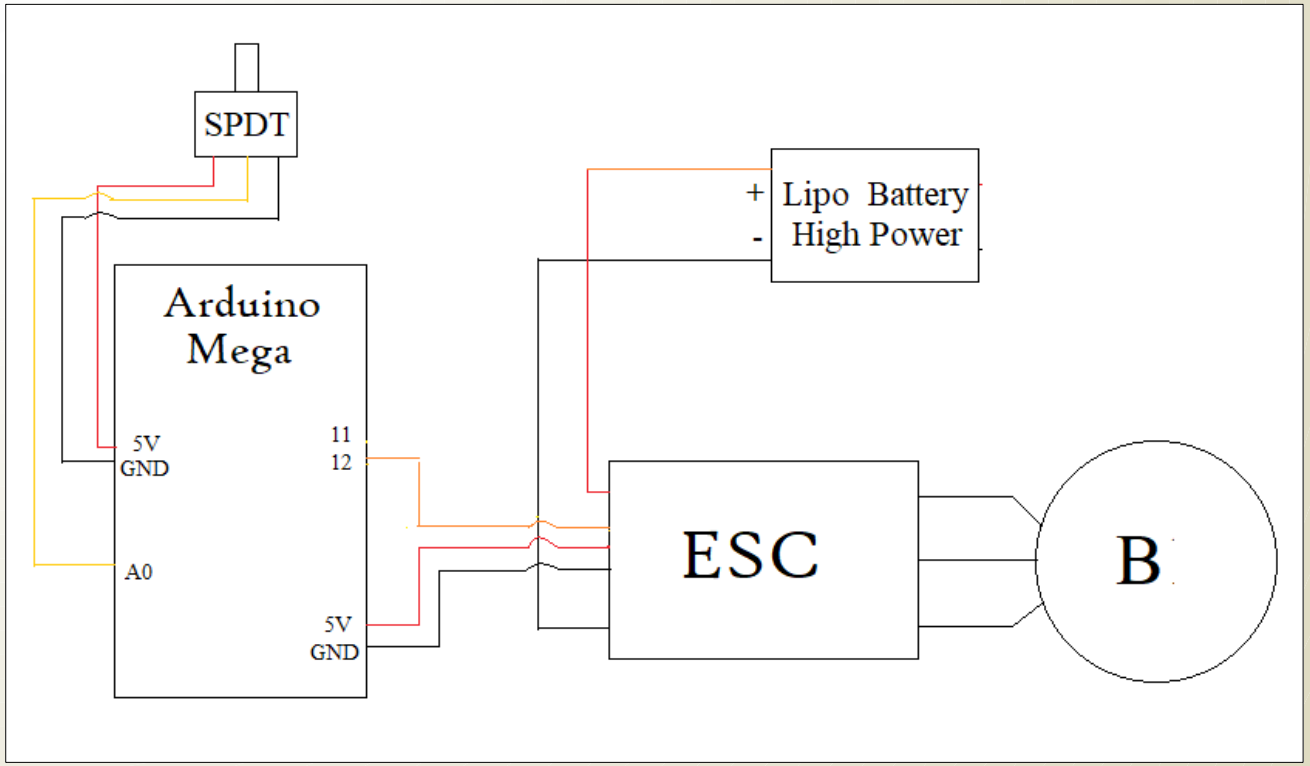
Inspector	Wall Climbing Robot
Expensive	Cheaper
One-way communication	Two-ways communication
Unsafe	Safe
Normal monitoring	Monitoring (video, sensors)
Few services	Many services

Subsystem 1: Chassis



Design of The Robot Chassis

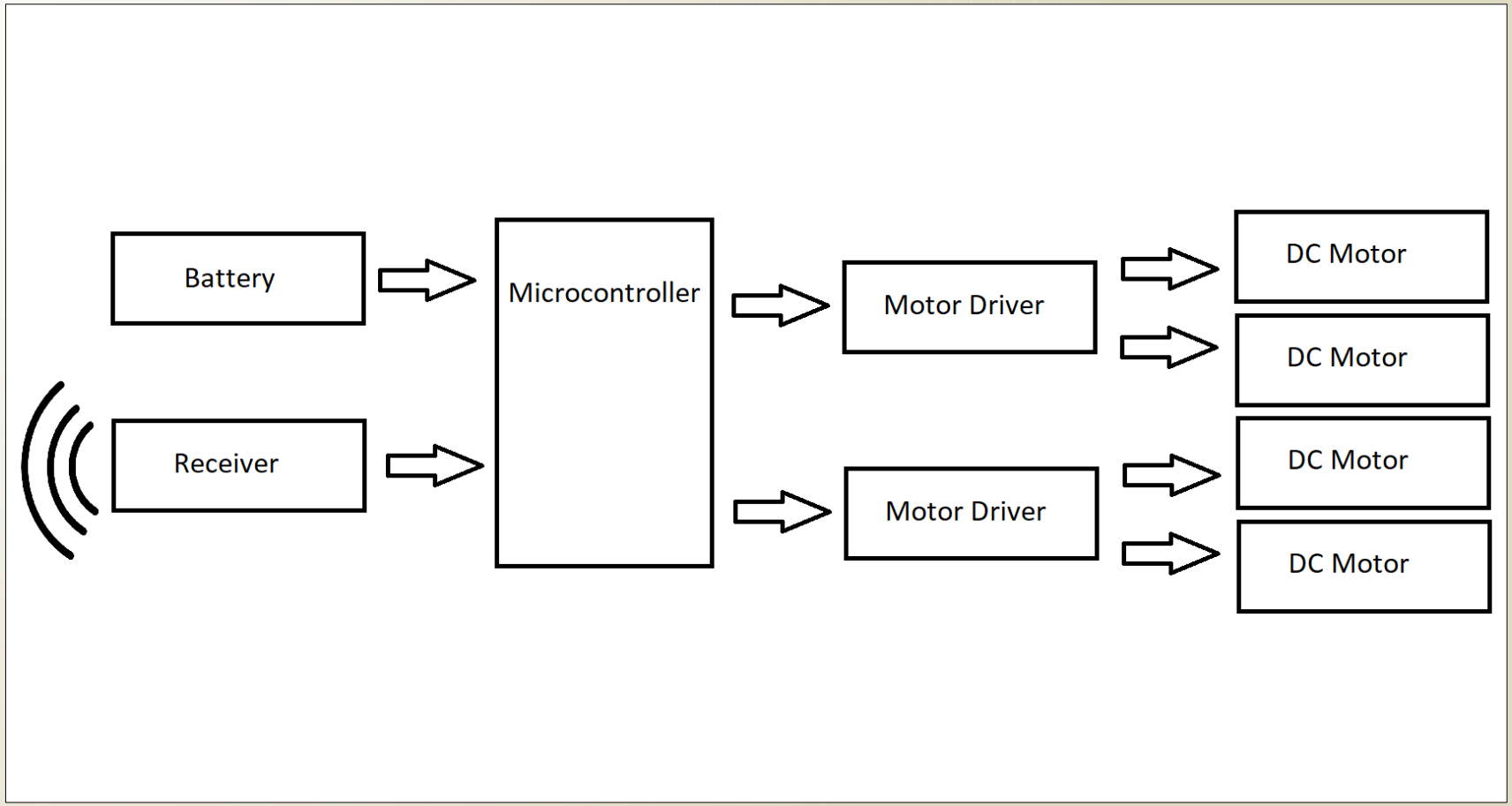
Subsystem 2: Suction Motor



Circuit Connection of one Brushless Motor

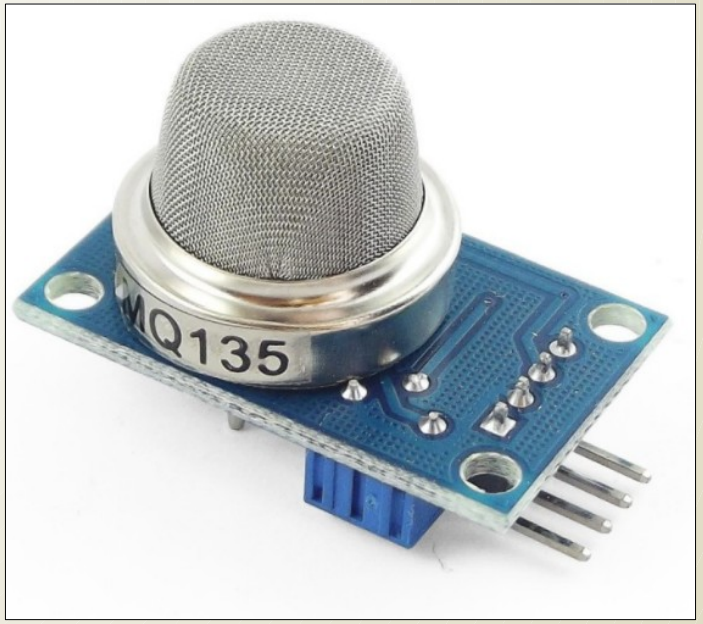
Subsystem 3: DC Motors

- Dictates movement, direction, and speed

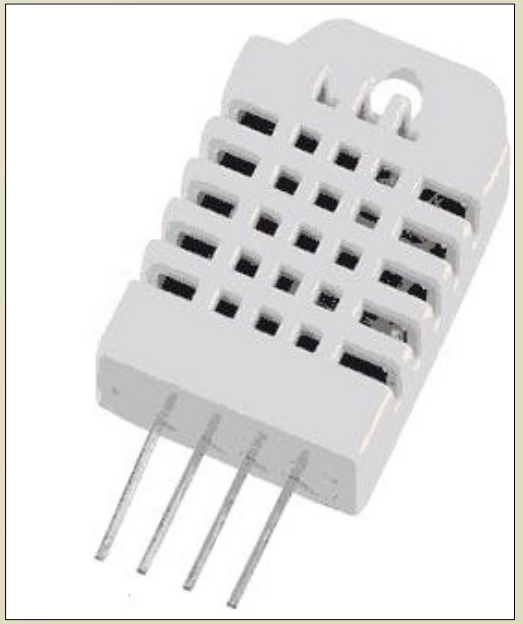


Subsystem 4: Sensors

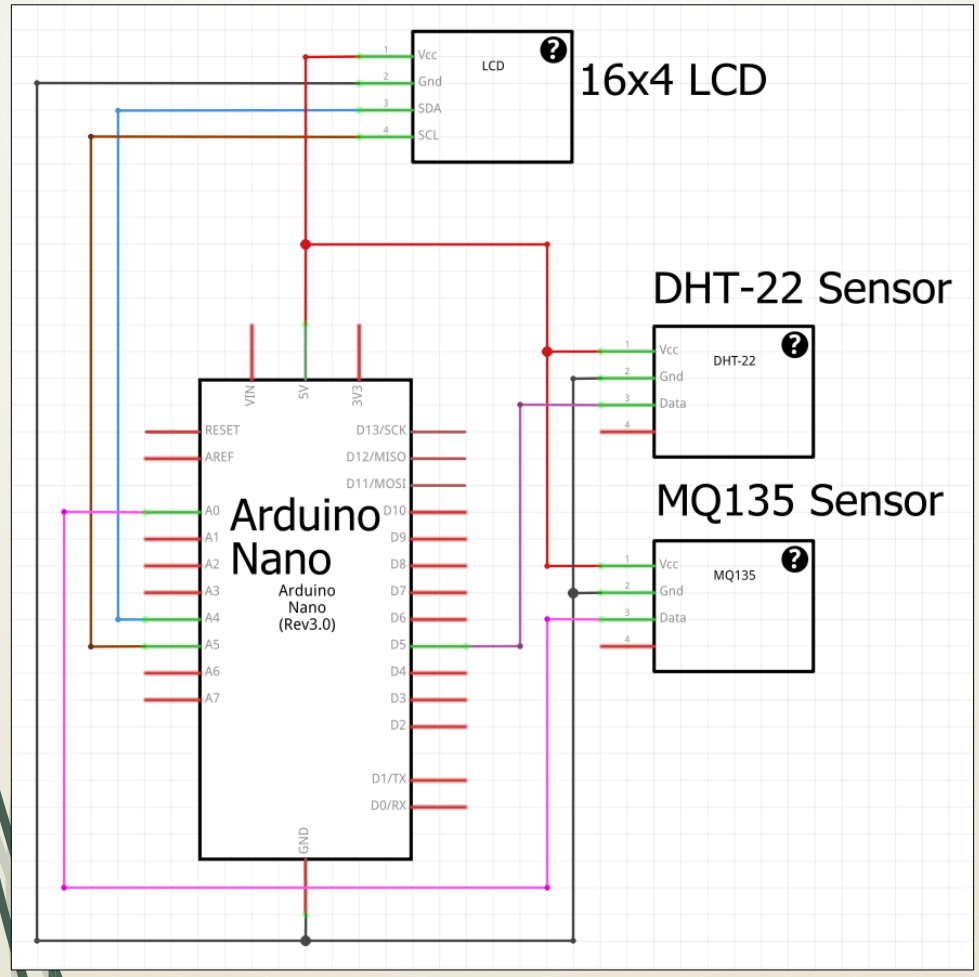
- Two sensors showing 3 readings
- Collects data from sensors
- Displays sensors data in LCD

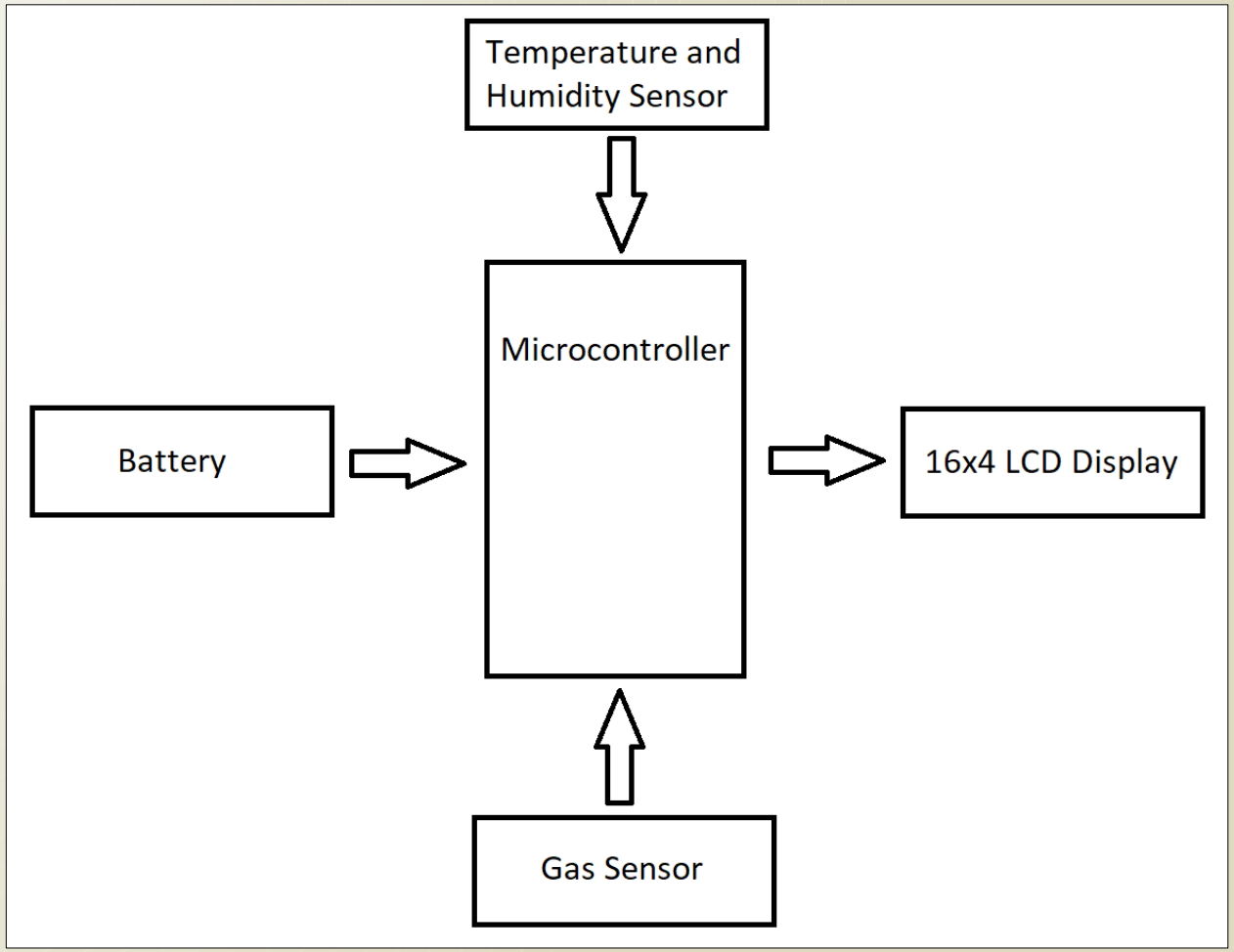


MQ135



DHT-22


LCD
16x4 LCD
Vcc
Gnd
SDA
SCL
DHT-22 Sensor
DHT-22
Vcc
Gnd
Data
MQ135 Sensor
MQ135
Vcc
Gnd
Data
Arduino Nano
Arduino Nano (Rev3.0)
VIN
5V
3V3
RESET
AREF
A0
A1
A2
A3
A4
A5
A6
A7
D13/SCK
D12/MISO
D11/MOSI
D10
D9
D8
D7
D6
D5
D4
D3
D2
D1/TX
D0/RX
GND

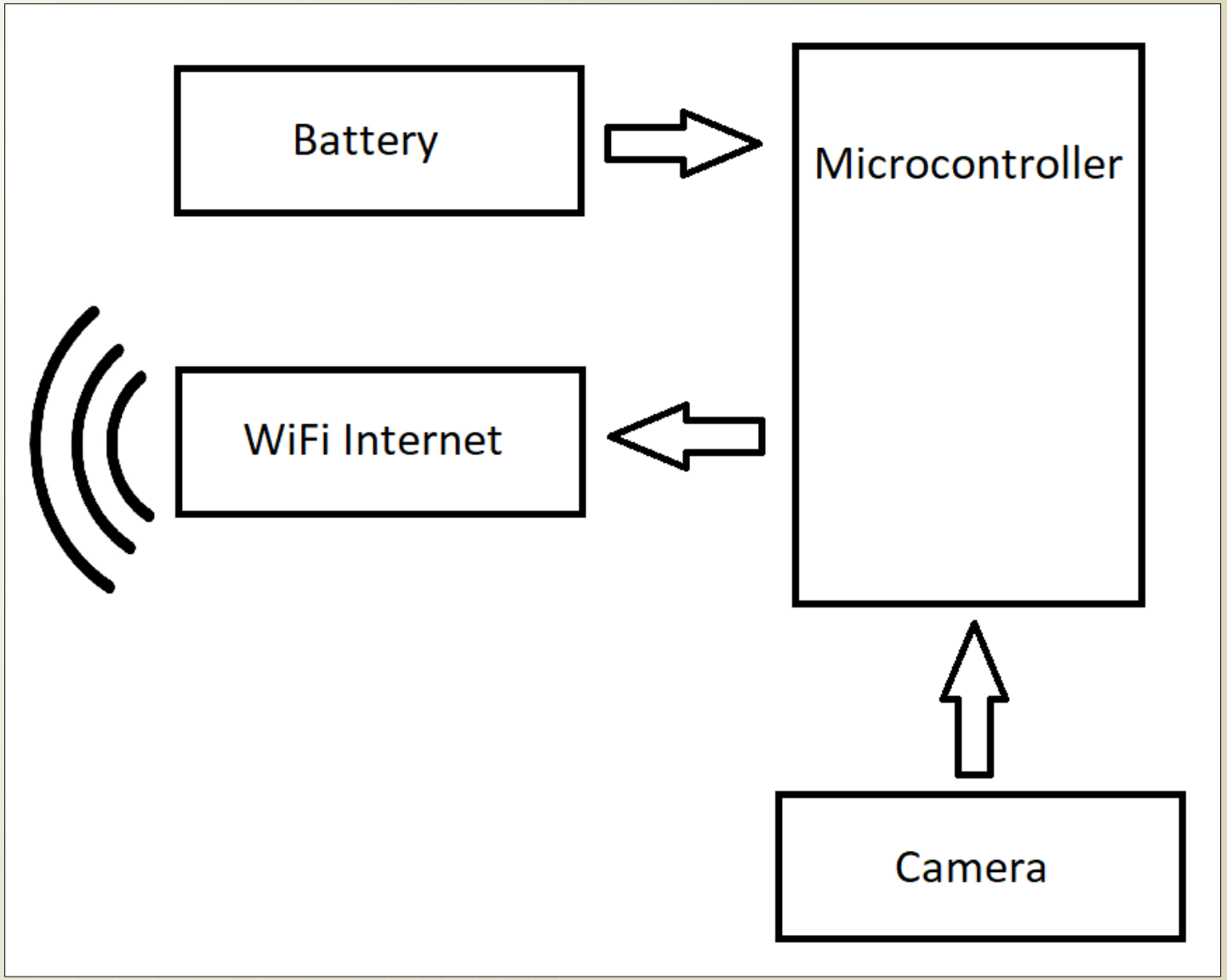

Temperature and Humidity Sensor
Microcontroller
Battery
16x4 LCD Display
Gas Sensor

Subsystem 5: Communications

- **Wireless Remote Control:**
  - Sends direction to robot
  - Compatible with most phones have Bluetooth

Video Streaming:

- Live streaming
- Compatible with most devices have WiFi



Design: Completed Work

- **Completed tasks are as follows:**

Task	Completed Task in Percentage
Chassis	100%
Wireless Remote Control	100%
Suction Motor subsystem	100%
DC Motors subsystem	100%
Video Streaming subsystem	100%
Test Wireless Remote Control with DC Motors subsystem	100%
Implement Gas and Temperature sensors	100%
Test Suction Motor subsystem	100%

Design: Remaining Work

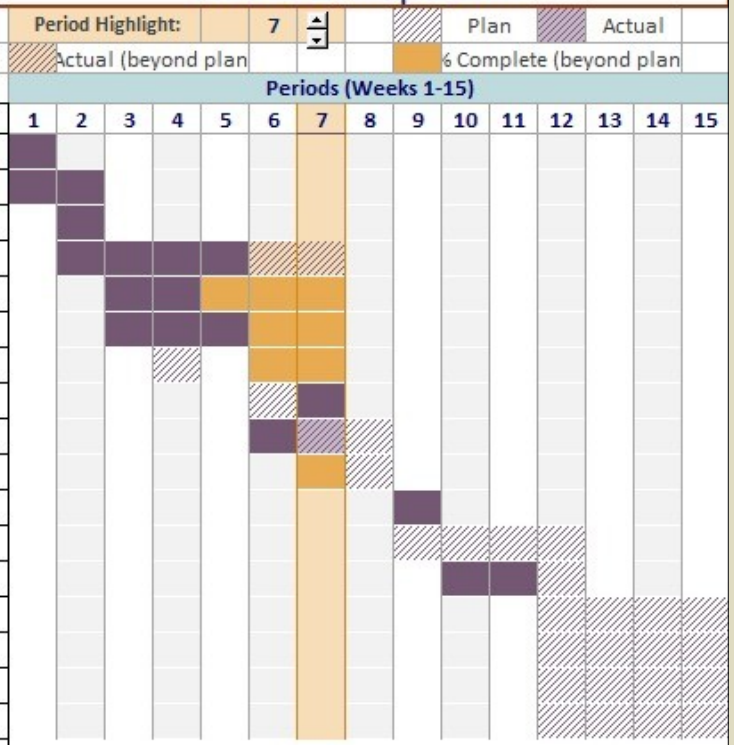
- Remaining tasks are as follows:

1. Integrate all subsystems and final test (100%)
2. Assemble the body (100%)

Project Management & Team Work

Title: Wall Climbing Robot (WCR)	Advisor: Mr. Ahmed Abul Hussain	Design II (ASSE 3)	Fall 2021
Abdallah Almarri 201500438 (AA)		Project PLAN & Progress	
Faisal Al Hajri 201600304 (FA)		ProgRpt No. 7	
Hassan Aloqaily 201302723 (HA)		Plan updated (Date): Dec.21, 2021	
Abdulwahab Abu Shaigah 201600890 (AS)		Instructor: Dr. Sadiq Alhuwaidi	

ACTIVITY	PLAN START	PLAN DURATION	Assigned To	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Chassis	1	1	ALL	1	1	100%
Wireless Remote Control	1	2	AS	1	2	100%
Write a plan	2	1	ALL	2	1	100%
Suction Motor subsystem	2	4	AA, AS, HA	2	6	75%
DC Motors subsystem	3	2	AS, FA	3	5	100%
Video Streaming subsystem	3	3	FA	3	5	100%
Test Wireless Remote Control with DC Motors subsy	4	1	AS, FA	6	2	100%
Implement Gas and Temperature sensors	6	2	AS, FA	7	1	100%
Test Suction Motor subsystem	6	3	AA, HA	6	2	30%
Prepare midterm presentation and video	8	1	ALL	7	1	100%
Midterm presentation and video	9	1	ALL	9	1	100%
Integrate all subsystems and final test	9	4	ALL			100%
Assemble the body	10	3	ALL	10	2	100%
Prepapre final report	12	4	ALL			60%
Prepapre final presentation	12	4	ALL			100%
Prepare project demo	12	4	ALL			100%
Submit Rpt/PPT/Brochure/Video...etc.	12	4	ALL			100%



Progress Details:	Issues (delay, etc.):
We got new propellers and installed them.	We face an issues from the lipo battery and trying to fix it.
Testing suctions motors still in progress.	tors we decieded to do modification on the chassis and have o
We made a new 3D printing design of the chassis with one suction motor.	It might takes 2 weeks to have it done.
	2 DC motors founded broken & we waiting for new replacment.

Project Management & Team Work

Task	Abdullah	Abdulwahab	Hassan	Faisal
Search & acquire components	25 %	25 %	25 %	25 %
Design & implement Subsystem	25 %	25 %	25 %	25 %
Testing	25 %	25 %	25 %	25 %
Write report & presentation	25 %	25 %	25 %	25 %

Risk management

	Source	Events	Threats	Response
1	**Battery duration**	Power off	Fall down	Charge or replace the batteries
2	**Heat**	PLA material melt	Sun / high temperature places	Work in normal temperature
3	**Team members**	Illness	Development/test delay	Sickness is unpredictable and unavoidable.
4	**Wind**	Robot fall down	High speed wind	Wait until high speed Wind stop

Impact of project

1. Reduce preparation time and working time.

2. Reduce the cost of services.

3. Reduce the number of death.

4. Ability to do many functions.

5. Ability to work everywhere.

New Skills Acquired and Applied

1. Learn about materials of the chassis and choosing the best material for our robot based on characteristics.

2. Learn about Lipo battery provides high voltage and long cycle life.

3. Learn about risk management of designing and implementing the system.

4. Learn about project management of planning and communicate and troubleshooting problems.

Budget Estimate

Item	Quantity	Unit Cost (SR)	Subtotal
Chassis and Body	1	450.00	450.00
DC Gear Motor	4	40.00	160.00
16x4 LCD I2C	1	51.75	51.75
Suction Motor	2	88.65	132.50
Magnet	8	--	--
Arduino Mega	1	186.00	186.00
Raspberry Pi 4 With Pi cam	1	--	--
HC-12	2	28.00	56.00
Dual-Bridge Drive	2	37.00	74.00
Battery Lipo 11 V	--	--	--
Temp And Humidity Sensor	1	22.00	22.00
Gas Sensor	1	28.00	28.00
Breadboard	1	10.00	10.00
Wires	--	--	20.00
Total			1333.0

Project Demo

Wall Climbing Robot (WCR) - YouTube

THANK YOU

If you have any questions don’t hesitate to ask