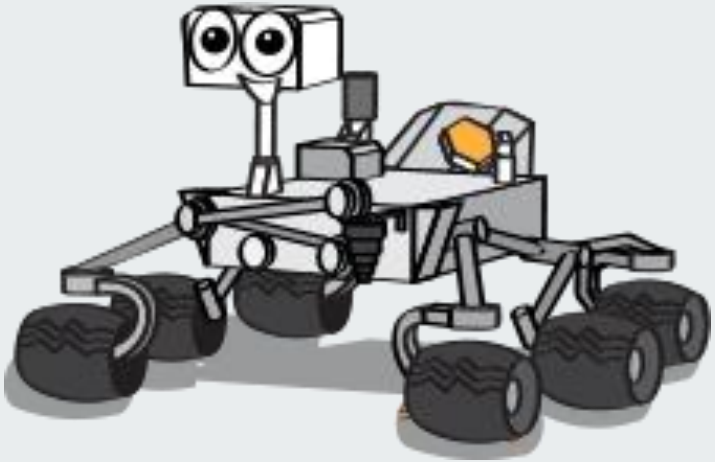
MARWIN

An Open Source Rapid Deployable DIY MARS Rover



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Contents

Introduction

- Ever growing demand and developments in space exploration industry have inspired us to create **MARWIN.**
- Rapid industrialization and entry of private firms in space industry have opened up new possibilities for startups.

Abstract: project background

- The basic aim behind the project is to address the need of open source projects in space industry.
- The **MARWIN** rover is designed to be modular and customizable according to various explorational needs.
- The basic use of **MARWIN** will be to avail rapid deployable rover solutions in human exploration of other planets.

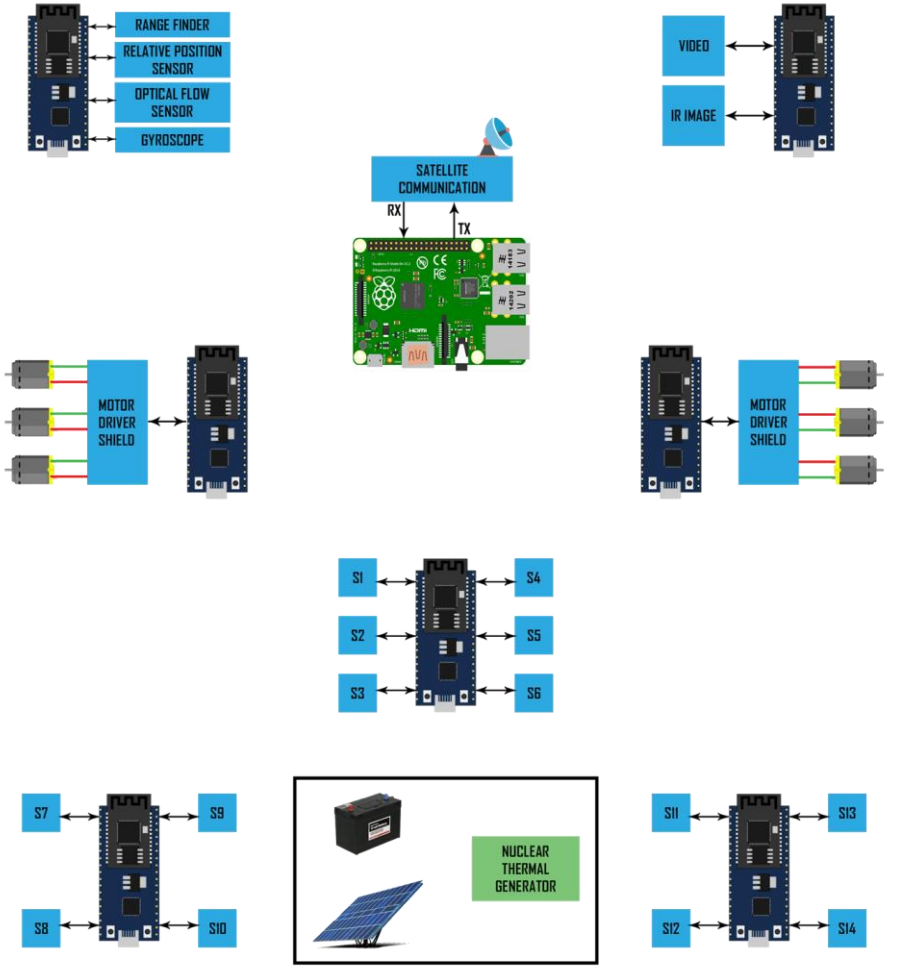
Problem statement:

- The working of space rover cannot be exhibited to the public directly and it is because of high maintenance costs.
- There is a lack of open-source projects that support space exploration and related technology.
- There is no available prototype or even design for rapid deployable modular rovers.

Design

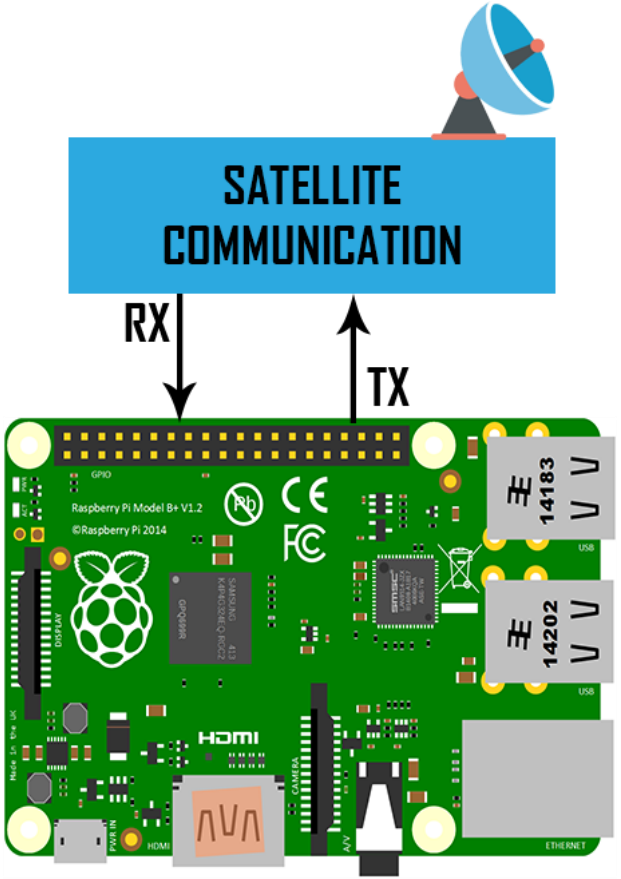
- The design principle of MARWIN is logically divided into 3*3*3 like Rubik's Cube design approach.
- We use Rocker Bogie mechanism for traversing through rough terrain.
- We provide any of the scientific equipment in this prototype.
    - Atmospheric content Sensor : Which enables us to detect the presence of different types of Gases.
    - Life detecting robotic system : Which detects the presence of biological life form.

Architecture

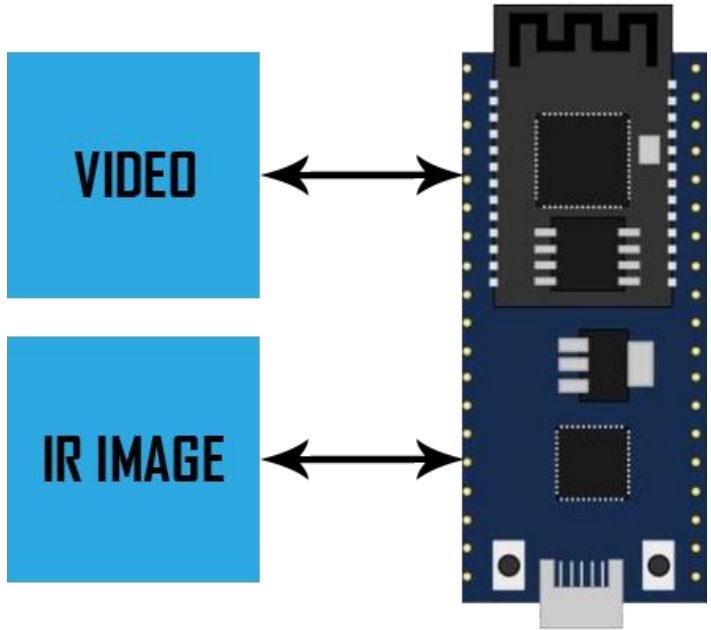


Raspberry Pi 3 B+

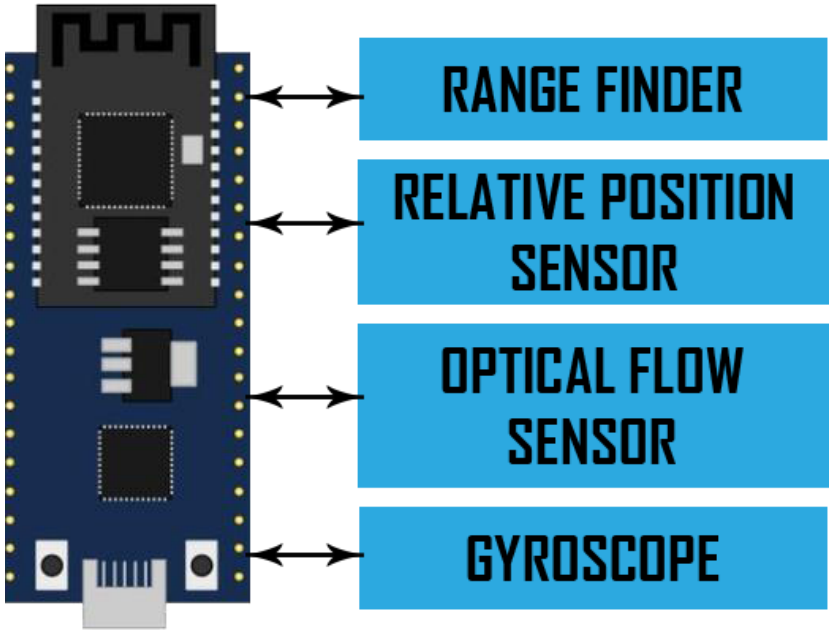
- It acts as the brain (Motherboard).
- Buffers all data in the internal server (Database).



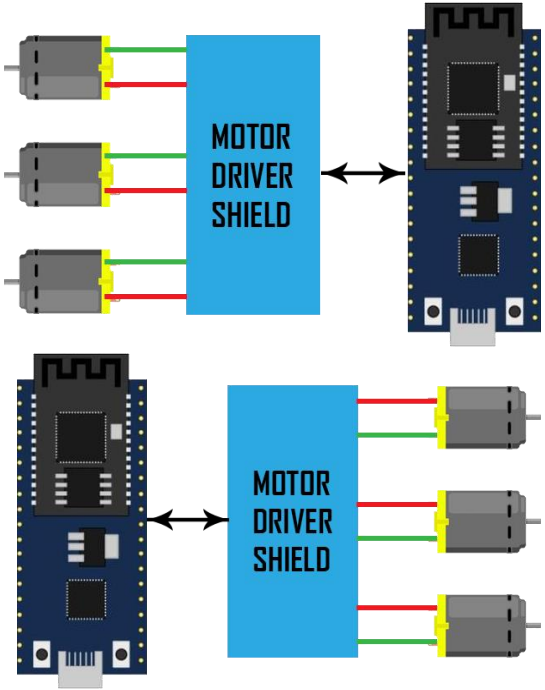
Live Analysis

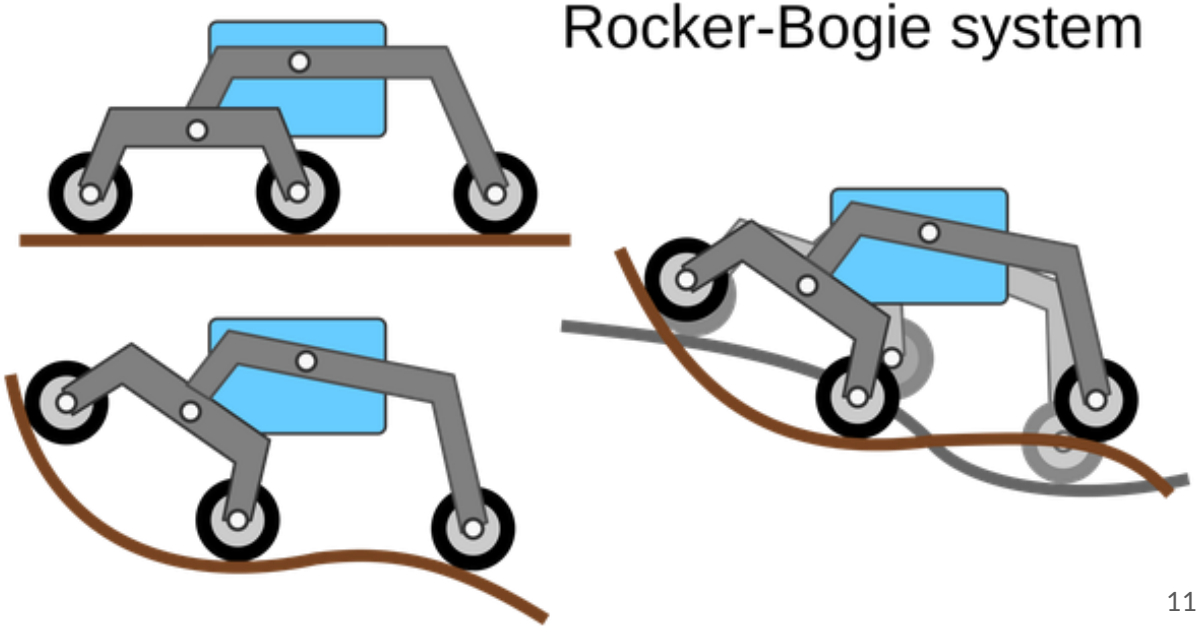


Navigation Block

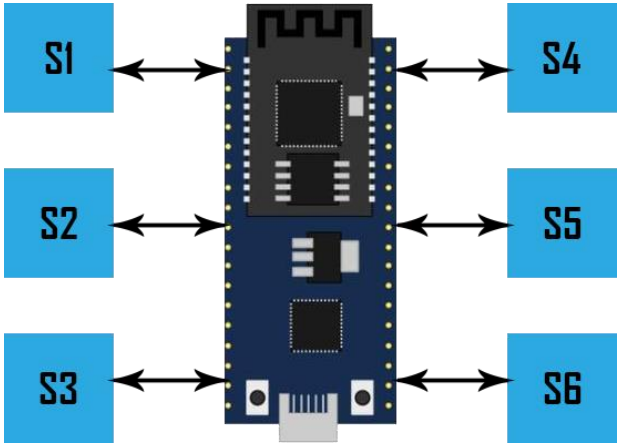


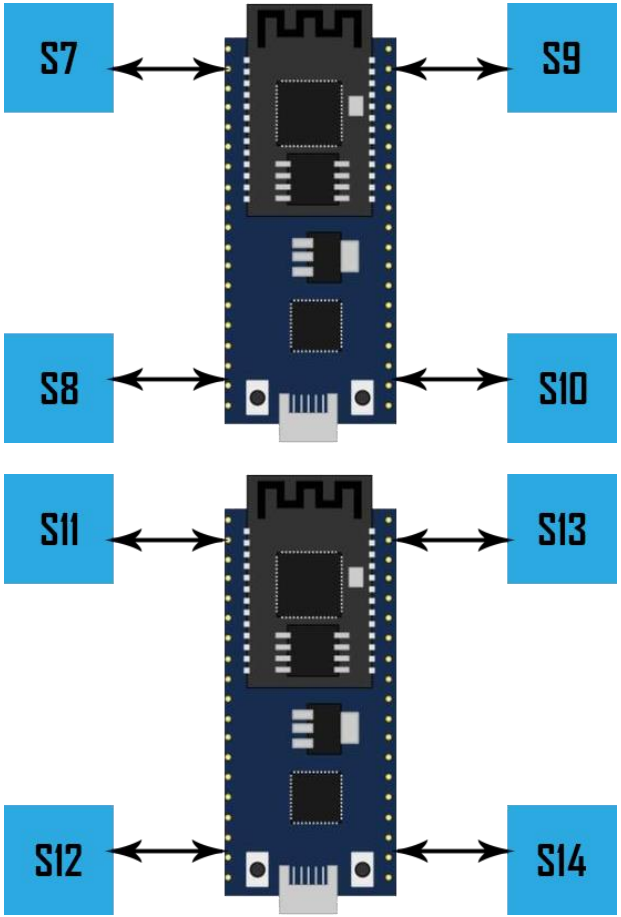
Left Wheel & Right Wheel



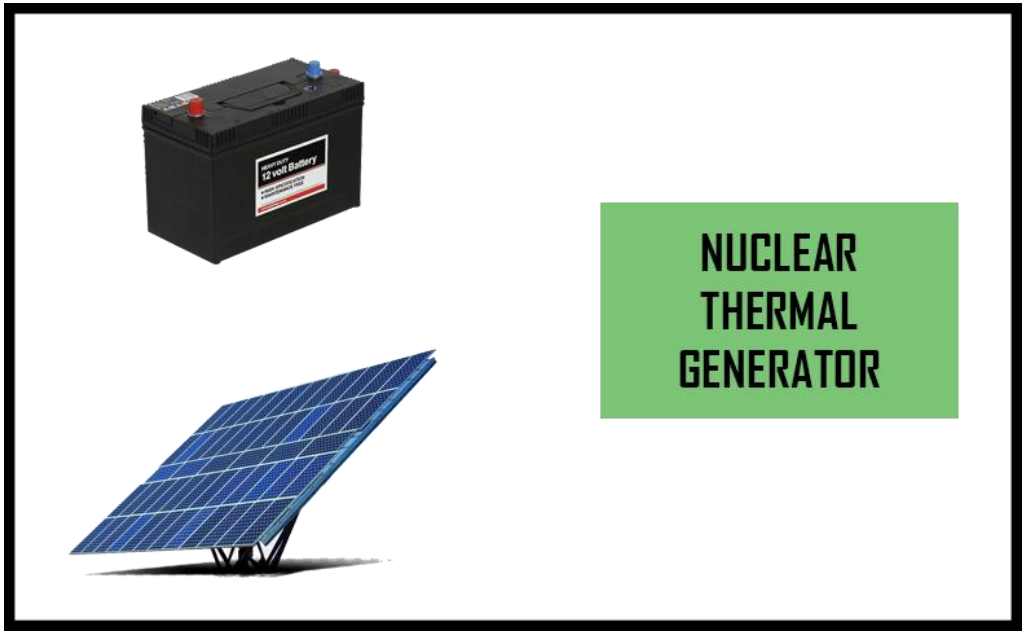


Sensor Cluster 1, 2 & 3





Power management block

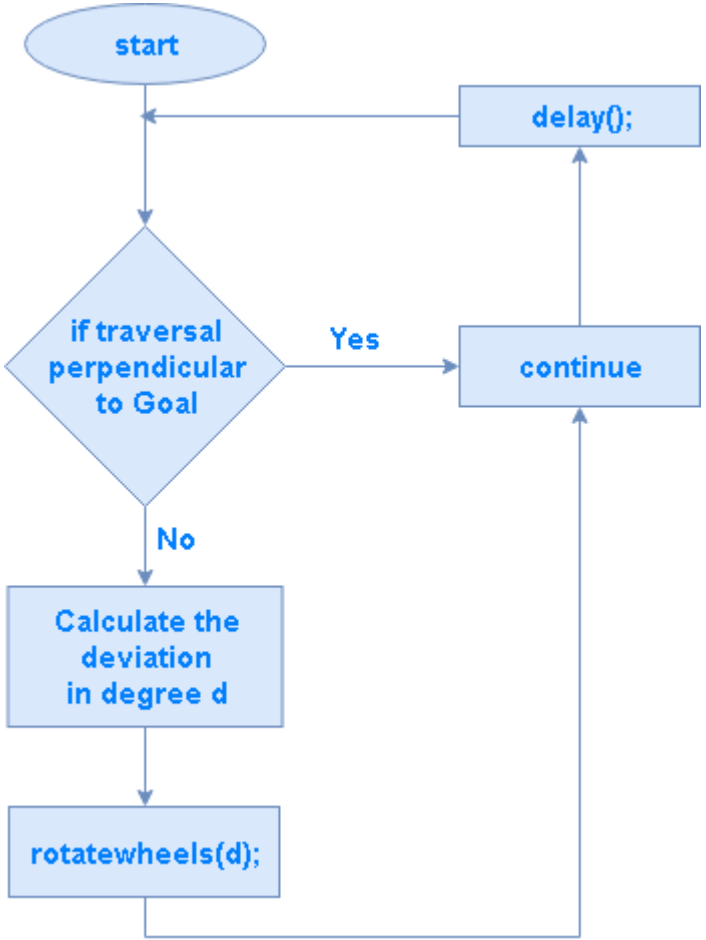


Implementation Plan

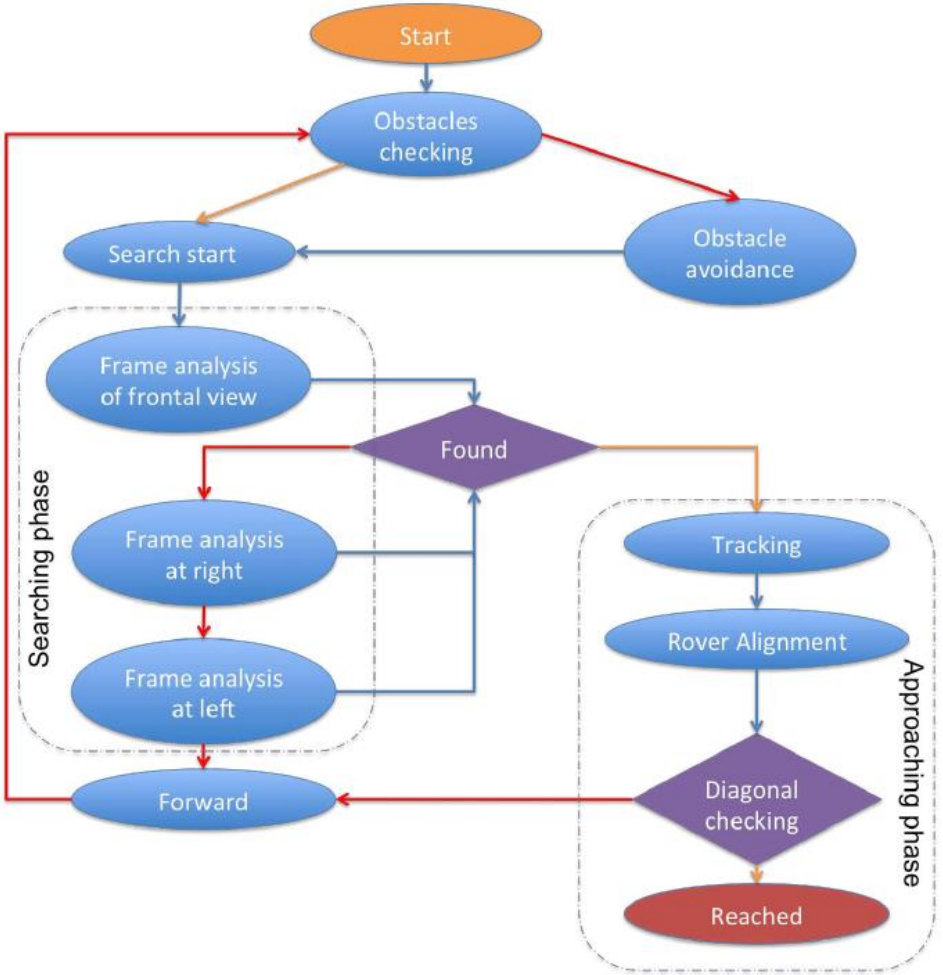
1. Rocker-Bogie system with RC .
2. Scientific equipments (sensor clusters).
3. Power management system.
4. Autonomous navigation.
5. Video streaming and analysis.
6. Testing and analysis.
7. Modification and finalizing the design.

Note: All the project work will be made open source via **GitHub**.

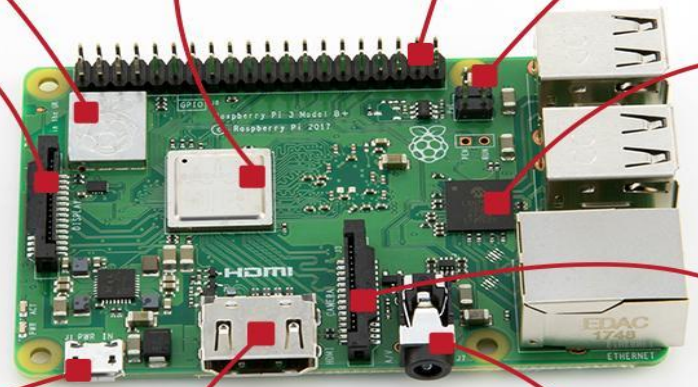
Goal Based Navigation



Rover Actions Flowchart



Raspberry Pi 3 Model B+



Extended 40-pin GPIO header

Power over Ethernet (PoE) header
(requires separate PoE HAT)

2.4GHz and 5GHz IEEE
802.11.b/g/n/ac wireless LAN,
Bluetooth 4.2, BLE

Broadcom BCM2837B0, Cortex-A53
64-bit SoC @ 1.4GHz
with 1GB LPDDR2 SDRAM

4 × USB 2.0 ports and
Faster Ethernet over USB 2.0
(maximum throughput 300Mbps)

MIPI DSI display port

56mm

MIPI CSI camera port

85mm

5V/2.5A DC via micro
USB connector

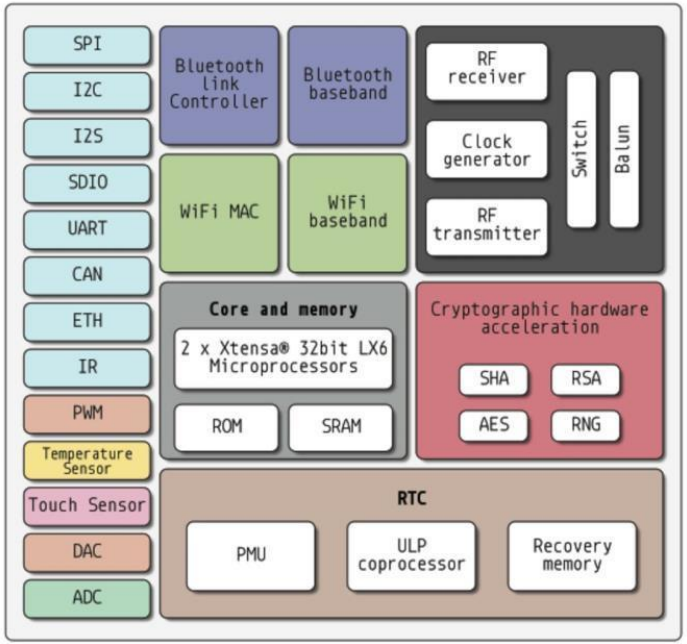
Full size HDMI

4 pole stereo output and composite video port

element14.com/RaspberryPi

element14 COMMUNITY

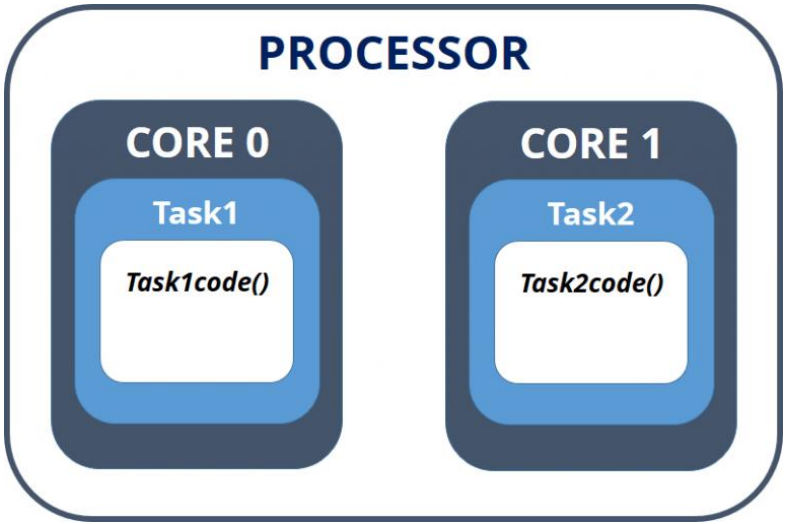
Why ESP32 ?



SPECS/BOARD	ESP32	ESP8266	ARDUINO UNO
Number of Cores	2	1	1
Architecture	32 Bit	32 Bit	8 Bit
CPU Frequency	160 MHz	80 MHz	16 MHz
WiFi	YES	YES	NO
BLUETOOTH	YES	NO	NO
RAM	512 KB	160 KB	2 KB
FLASH	16 MB	16 MB	32 KB
GPIO PINS	36	17	14
Busses	SPI, I2C, UART, I2S, CAN	SPI, I2C, UART, I2S	SPI, I2C, UART
ADC Pins	18	1	6
DAC Pins	2	0	0

ESP32 dual core

- Each core can do different task independently.
- Sync can be achieved via Mutually Exclusive Semaphores.
- The 32bit dual core clocked at 180Mhz can outperform AtMEga328p(Arduino UNO R3) by



Sensor list

- MQ-2 - Methane, Butane, LPG, smoke
- MQ-3 - Alcohol, Ethanol, smoke
- MQ-4 - Methane, CNG Gas
- MQ-5 - Natural gas, LPG
- MQ-6 - LPG, butane gas
- MQ-7 - Carbon Monoxide
- MQ-8 - Hydrogen Gas
- MQ-9 - Carbon Monoxide, flammable gasses

- MLX90614 - IR temperature sensor
- MAG3110 - Magnetometer
- ITG 3200 - Gyroscope
- ADXL 345 - Accelorometer
- TSL 102 - Luminosity sensor
- ML8511 - UV detector
- BMP180 - Barometric Pressure/altitude sensor
- MMA84551 - Inclination sensor

Literature survey

- Terrain feature extraction and assessment.
- Terrain-Based Navigation
- Obstacle-Avoidance Navigation
- Goal-Based Navigation
- Behavior Integration

Paper: An Intelligent Terrain-Based Navigation System for Planetary Rovers

Literature survey (cont….)

- Wheel supporting system.
- Wheel defect detection
  - Wavelet-SVM
  - Deep Learning

Paper: Wheel defect detection using machine learning.

Literature survey (cont....)

- Prototype for searching signs of life in mars.
- Laser and reflectometer tech to detect traces of methane.
- Surveying and localization of data.

Paper: Robot System to Search for Signs of Life on Mars

Applications.....

Highly modified versions of the rover can be used in fields such as

1. Defence .
2. Rescue operations.
3. Disaster management.
4. Remote sensing.
5. Agriculture.
6. R&D.

And more...

Thank you !!