

Product Design Specification

City of Glasgow College

HND Electronics Graded Unit Project

SARRRO

Gavin Hannah

N10161454

2012/13

Contents

1.0 Foreword.....	3
2.0 Scope of Specification	3
3.0 Role of SARRRO	3
4.0 Definitions.....	3
5.0 Related Documents & References	4
6.0 Relevant Agencies	5
7.0 Conditions	5
8.0 Characteristics.....	6
9.0 Performance	8
9.1 Validation.....	9
10.0 Safety	9
11.0 Packaging & Protection	9
12.0 Software.....	9
13.0 Supplier to User Information	10
13.1 Technical Data.....	10
13.2 After Sales Services	10
13.3 Guarantees and Warrantees	10
13.4 Complaints and Compensation	11
13.5 Environmental Aspects	11
14.0 SARRRO Technical Features	Error! Bookmark not defined.
SARRRO MOTHERBOARD	Error! Bookmark not defined.
SARRRO ULTRASONIC EMITTERS.....	Error! Bookmark not defined.
SARRRO ULTRASONIC RECEIVERS	Error! Bookmark not defined.

Product Specification to BS.7373

1.0 Foreword

SARRRO (Search and Rescue & Reconnaissance Rover) is an autonomous four wheeled robot. It is a technological showcase for automated exploration of areas considered to have too high a risk for emergency personnel to enter.

SARRRO will be capable of self guidance and obstacle avoidance and will be capable of short range radio communication with a remote human operator and can relay live data back to the human operator.

Any mention of the following; Robot, Rover, SARRRO. Will reference to the aforementioned product.

2.0 Scope of Specification

- + Materials Specification
- + Chassis Design
- + Electrical Characteristics
- + Radio Characteristics
- + Mechanical Characteristics

This specification will outline the properties and characteristics of SARRRO along with its capabilities.

3.0 Role of SARRRO

SARRRO is intended to demonstrate the technology as a viable solution to search and rescue efforts within a hazardous location that is considered to be too dangerous for rescue personnel to enter, or for accessing a location that is otherwise, inaccessible to rescue personnel.

4.0 Definitions

- **4.1 Terminology**

SARRRO – Search & Rescue and Reconnaissance Rover
MCU – Microcontroller Unit

- **4.2 Symbols & Abbreviations**

V – Volts
RPM – Revolutions per minute
Ah – Amperes Hours
Hz – Hertz
W – Watts
m – Meters

- **4.3 Measuring Systems**

V(Volts)- Electromotive force
Ah(Amperes Hours) – Number of hours SARRRO can draw one amp of electrical current.
W(Watts) – Unit of Electrical power.
Hz(Hertz) – Unit of frequency. 1Hz = one cycle per second.
mm(Millimetres) – Unit of measurement.
KG(Kilograms) – Unit of measurements.
RPM(Revolutions per minute) – Number of rotations of mechanical object in a minute.
Circuit Diagrams – Engineering schematics.

5.0 Related Documents & References

British Standards and Codes of Practice

BS – British Standards

National Standards International

ISO – International Standards Organisation
EN – European Standards
UL – Underwriters Laboratories Inc (Product Safety Testing)
CE – Certificate European

Applicable to Bluetooth Device RN-41, Roving Networks.

+RADIO

USA FCC ID:

FCC CFR47 Part 15 C, para 15.247
T9J-R41-1

Europe:

EN 300 328-1
EN 300 328-2 2.4GHz

Canada IC Canada ID:

IC RSS-210 low power comm. device
6514A-RN411

+EMC

USA:

FCC CFR47 Part 15 subclass B

Europe:

EN 55022 Class B radiated
EN61000-4-2 ESD immunity
EN61000-4-3 radiated field
EN61000-4-6 RF immunity
EN61000-4-8 power magnetic immunity

+Bluetooth: LISTED B013180

+Environmental: RoHS RoHS compliant

6.0 Relevant Agencies

<http://environment-agency.gov.uk> WEEE (Waste Electrical & Electronic Equipment)
SEI (Sustainable Electronics Initiative) US Only

7.0 Conditions

- 7.1 Environmental

SARRRO is a technological prototype and has not been designed for extreme weather. It is to be used indoors only during the prototype testing.

Nominal Operation Conditions:

Indoors Only

-10°C - 40°C

≤ 50+ Rel. Humidity

≤ 10° Surface Gradient

Min Ground Clearance of 5CM

Non Explosive Atmosphere

- 7.2 Relation To Other Equipment

SARRRO is physically comparable to other Robots of a wheeled nature.

SARRRO is computationally comparable to low level intelligence Robots that operate with embedded systems.

- **7.3 Usage**

Its power source will need to be regularly charged prior to use to ensure maximum longevity of SARRRO once deployed.

SARRRO should not be exposed to any conditions beyond nominal to reduce the risk of damage to the rover.

- **7.4 Servicing**

Servicing of SARRRO should only be carried out by a qualified Electronic Engineer or the manufacturer in the case of any malfunction.

8.0 Characteristics

- **8.1 Design**

- **8.1.1 Mechanical**

Wheels

SARRRO is a four wheeled rover. It is equipped with two DC Bi-Directional Motors. Each motor controls two wheels on either the left or right side of SARRRO. Steering is accomplished by controlling the left or right hand side wheels independently.

Each wheel is made from plastic which is covered with treaded rubber to provide grip.

Chassis

The chassis is a prototype chassis which is made from a re-purposed remote control vehicle.

- **8.1.2 Electrical**

Battery

SARRROs' battery is a 7.2V 3000mAh battery. It should be located within the chassis at the back of SARRRO.

Motors

SARRRO is equipped with two, DC Bi-Directional 6V Motors.

Electronics

- + Motherboard: The motherboard for SARRRO is a mounted PCB which should be mounted on top of the rovers' chassis.
- + CPU: SARRRO uses a PIC18F4550 microcontroller manufactured by Microchip.
- + Navigation: SARRRO uses three sets of Ultrasonic Sensors that operate at 40KHz.
- + Drive: SARRRO uses a L298 H-Bridge Driver to control the rovers' motors.
- + Sensors: SARRRO is equipped with Ultrasonic sensors, Temperature sensor, and a Humidity sensor.
- + SARRRO is equipped with radio communication in the form of Bluetooth 2.1.

Total Power Consumption

Nominal Operation:

Idle/Standby:

- **8.1.3 Radio**

SARRRO uses a Bluetooth 2.1 radio communication module RN-41 manufactured by Roving Networks.

It broadcasts on 2,402 ~ 2,480 MHz and has a range of 100m.

Average Power Consumption:

- Standby/Idle (Default Settings) 25 mA
- Connected (Normal Mode) 30 mA
- Connected (Low-Power Sniff) 8 mA
- Standby/Idle (Deep Sleep Enabled) 2.5 mA

- **8.1.4 Physical Characteristics**

Dimensions: W: 175mm L: 200mm H: 150mm

Weight: 640g

Wheel Diameter: 55mm

Wheel Circumference: 172.7mm

- **8.1.5 Materials**

Composition

Chassis: Polyethylene (HDPE) and Steel

Wheels: Polyethylene (HDPE) + Synthetic Rubber

PCB: FR-4 (Woven Glass & Epoxy)

- **8.2 Manufacturing Process Requirements**

Prototype

The prototype is hand built. It requires manual assembly.

- **Mass Production**

There are no plans to mass produce. Each subsequent product will be built to order.

- **Appearance**

The prototype will be of an exposed appearance and without a durable, weather or waterproof shell.

The final product should have a water and weatherproof durable shell made of a tough rigid plastic.

9.0 Performance

- **9.1 Performance Under Specified Conditions**

SARRRO should be able to operate autonomously and be able to communicate with a human operator within a 100m radius.

It should avoid collisions with obstructions.

It should have a minimum of 10 minutes of battery power available when fully charged.

It should respond to instructions given to it by a human operator.

It should accurately determine the ambient temperature and humidity and relay this information to a human operator.

- **9.2 Test Methods**

Navigation + Collision Avoidance

SARRRO will be tested within an environment designed to recreate:

- 1) A hazardous environment with obstacles.
- 2) A small inaccessible environment with confined space.

Radio

Radio communication with SARRRO will need to be maintained to the designated range during testing.

SARRRO will transmit sensory data and receive commands out to the designated reception range.

Battery

SARRRO will be operated until the battery is unable to operate the CPU and timed to ensure it meets the required time requirements.

Test Results

See Documents: Simulation Results, Test Specification.

9.1 Validation

The finished product will come with a product validation card to indicate that the product has been tested and meets all the product requirements.

10.0 Safety

SARRRO will conform to required Health & Safety Legislation applicable to it.

11.0 Packaging & Protection

SARRRO should be stored in a moisture free container and protected against vibration during transportation.

SARRRO (Prototype) should be kept away from water and excessive moisture and kept free of dust and dirt.

SARRRO (Prototype) should have the MCU removed from the rover when not in use and placed within a storage container (supplied).

Anti-Static wrist straps should be used when handling any of SARRROs electronic components to prevent static surges in sensitive components.

12.0 Software

SARRRO will come with a Software Installation disk which will install SARRRO specific software to facilitate human operation of SARRRO.

The following should exist in the form of an Instruction Manual

13.0 Supplier to User Information

- Operating Instructions
- Safe Use Guidelines
- Storage Guidelines
- Servicing and Troubleshooting Procedures

The instruction manual will be in an electronic format and come supplied on the accompanying software installation disk.

13.1 Technical Data

- Battery Ratings
- Operating Life Span
- Wireless Communication & Ratings

13.2 After Sales Services

Help line number for;

- Operating Queries
- Maintenance Options

Contact numbers and email address for Distributor and Manufacture to be supplied.

13.3 Guarantees and Warrantees

If SARRRO becomes defective due to faulty materials / workmanship within 24 months from date of delivery, the manufacturer will guarantee to either replace the unit free of charge provided that:

- The product is returned to the manufacturer or authorized repairer with the date of delivery.
- The product has not been subject to misuse or neglect.
- Repairs have not been attempted by anyone other than the manufactures service staff or authorized repair distributor.
- The product has not sustained damage through foreign objects, substances or accidents.

A guarantee card will be provided which must be filled in and returned to the manufacturer upon receipt of the product.

13.4 Complaints and Compensation

A complaints number should be stated.

13.5 Environmental Aspects

The manufacture will accept back broken products that are of no further use so they can be disposed of or recycled in an environmentally safe way.