Radio Mobile Foxbot

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Interface Control Document

INTERFACE CONTROL DOCUMENT
FOR
Radio Mobile Foxbot

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Change Record

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1. Overview

This document is provided to detail how the microcontroller, power system, and radio will interface. The ICD will include the physical descriptions of the Radio Mobile Foxbot this includes the electrical components, sensors, and other various inputs. This document will also explain how each of the subsystems will interface alongside each other to complete the objectives described in the ConOps and FSR documents.

2. References and Definitions

2.1. References

MIL-STD-810F
Environmental Engineering Considerations and Laboratories Tests
1 Jan 2000
Change Notice 2
30 Aug 2002

American National Standard for VME64 (ANSI/VITA 1-1994 (R2002))
4 Apr 1995

American National Standard for VME64 Extensions (ANSI/VITA 1.1-1997)
7 Oct 1998

2.2. Definitions

DTMF	Dual Tone Multi-Frequency
FCC	Federal Communications Commission
mA	Milliamp
mW	Milliwatt
MHz	Megahertz (1,000,000 Hz)
TBD	To Be Determined
RF	Radio Frequency
Ah	Amp-Hour
FFT	Fast Fourier Transform

3. Physical Interface

3.1. Weight

Component	Weight
Chassis	7 lbs
Motors	360g each (2x)
Lipo Batteries (Motor Control)	134g
Lipo Battery (Control Unit)	376g
Baofeng UV-5R	130g
Pixhawk	93.9g
GPS	36g
Ultrasonic Sensor	2.89oz each (2x)
Microcontrollers	0.348645oz each (2x)
Sabertooth Dual 12A Motor Driver	2.20oz
Miscellaneous	

Table 1: Radio Mobile Foxbot Weight Specifications

3.2. Dimensions

3.2.1. Dimensions of MCU Subsystem

Component	Length	Width	Height
Pixhawk	84.8mm	12.4mm	44.0mm
ESP32-WROOM	18.0mm	19.22mm	3.20mm
Sabertooth Dual 12A Motor Driver	64.0mm	75.0mm	16.0mm

Table 2: MCU Subsystem Dimension Specifications

3.2.2. Dimensions of Transmission Subsystem

Component	Length	Height	Width
Baofeng UV-5R	58mm	110mm	32mm
PCB	TBD	TBD	TBD

Table 3: Radio Subsystem Dimension Specifications

3.2.3. Dimensions of Power/Sensor Subsystem

Component	Length	Height	Width
Lipo Battery (Control Unit)	155mm	46mm	23mm
Lipo Batteries (Motor Control)	105mm	33mm	17mm
Ultrasonic Sensor	33.02mm	10.16mm	30.48mm
GPS	54mm (diameter)	N/A	14.5mm (thickness)
PCB	TBD	TBD	TBD

Table 4: Power/Sensor Dimension Subsystem

3.3. Mounting Locations

3.3.1 Placement of Foxbot

The Foxbot will need to be placed on a level piece of land determined by the user. There should be no stairs, water, ditches, or environmental factors that could interfere with the movement of the foxbot.

3.3.2 Mounting of Sensors

The sensors will be placed on the front two corners of the chassis to allow for optimum surveying of the environment. A component that is 3D printed will be required to mount the sensors to the chassis to protect it from the elements and for secure attachment. Screws will be utilized to connect the component to the chassis itself.

3.3.3 Mounting the Radio

The body of the radio will be mounted under the chassis and held in a 3D-printed box. Screws will be needed to securely attach the box component to the chassis. The antenna will be mounted on the top of the chassis in a vertical position for ample signal transmission. There will need to be some component holding the antenna up and protecting it from environmental factors.

3.3.4 Mounting the Control Unit

The control unit will be held under the chassis in a 3D-printed box. This box will be securely attached to the chassis via screws. The control unit will consist of the Pixhawk, ESP32, and GPS components.

3.3.5 Power Supply

The battery will be connected to the robot chassis via velcro. This velcro will allow for the battery to be secured, but can still be removed in case of recharge.

4. Thermal Interface

The microcontroller will be constantly running calculations to keep the Foxbot system going, leading to the possibility of it overheating. The radio could also experience heating issues due to the 2 hour period of the Foxhunt. Environmental factors could also impact the thermal effects of the system. To combat these, a heat sink will be implemented for the main MCU subsystem in order to keep the system operating efficiently.

5. Electrical Interface

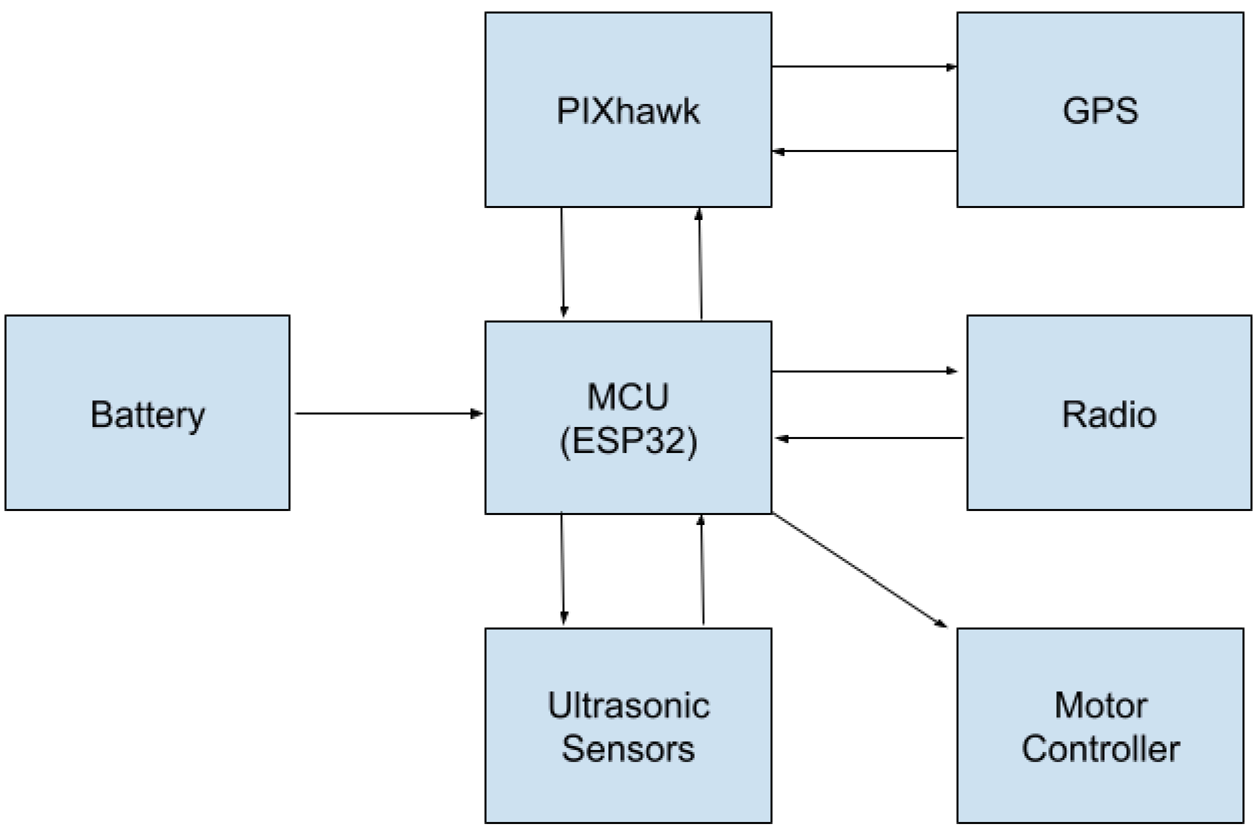

Figure 1: Electrical Interface Diagram

5.1. Primary Input Power

5.1.1. Control Unit Power

This system will contain all the components and their respective drop down voltage regulator, this system will be powered via the 11.1v 5500 mAh Lipo battery. This battery will have enough capacity to run the system for a minimum of 2 hours while the system is at peak consumption. The control unit will also track the voltage of said lipo battery.

5.1.2. Motor Control/ Motor Power

The SaberTooth motor controller and the two motors on the robot chassis will be powered via the two 7.4V 2200 mAh Lipo batteries. The control unit will monitor the voltage of these batteries.

5.2. Voltage and Current Levels

5.2.1. Control Unit Operational Values

Component	Voltage [V]	Current [mA]	Power[mW]
Baofeng Radio	7.4	1780	13172
ESP32-WROOM (Qty = 2)	3.3	160	528
HC-SR04 (Qty = 2)	5.0	30	150
M8N	5	150	7500
Radio Transmission System	TBD	TBD	TBD

Table 5: Control unit operational Voltage and Current Levels

The values of table 5 allow for accurate gauging of average power consumption. The values represented in this table allow us to estimate the total power consumption.

5.2.2. Motor Controller and Motors Operational Values

Component	Voltage [V]	Current [A]	Power[W]
Sabertooth Dual Motor Driver	24	24	576
IG42 24VDC 122 RPM Gear Motor (Qty = 2)	24	1	24

Table 6: Control unit operational Voltage and Current Levels

The values of table 6 allow for accurate gauging of average power consumption. The values represented in this table have come from SuperDroids website and allow us to estimate the total power consumption.

5.3. Signal Interfaces

5.3.1 Motors Interfacing

The MCU will communicate with the motors through the UART pins. Data will also be gathered from the Pixhawk as the Foxbot formulates its path. The motors will move based off of the Pixhawk and MCU data.

5.3.2 Sensor Interfacing

Data from the sensors will communicate with the MCU by reading in pulses to measure if objects are in the path of the Foxbot. The path of the Foxbot will be autonomously updated based on the signals received.

5.4. User Control Interface

The interface that will be used is a secondary Baofeng UV-5R utilizing the DTMF system in place. This radio will act as a remote controller and allow the user to interact with the system utilizing the numerical keypad. Each key will represent a different tone and allow level selection and more.

6. Communications / Device Interface Protocols

6.1. Wireless Communications (DTMF)

The transmission system will be controlled by DTMF signals from the repeater. These tones will be decoded by the microcontroller to produce transmissions selected by the user.

6.2. Device Peripheral Interface

The Sabertooth 12A Motor Driver is controlled through a serial port using UART and the ESP32 UART pins. Other devices that will be connected to the ESP32 UART pins will be the GPS and Pixhawk