Product Design Specification
(Project Fear Bot)

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Executive Summary/Concept of Operations

Fear Bot is a small, autonomous, wheeled robot which "runs" away from detected noises above a certain threshold. The amount of "running away" that occurs is proportional to the amount of noise that is detected. If screamed at, it'll run. And if whispered, it'll merely edge away. Its purpose is humorous entertainment; it is intended for use by novelty enthusiasts. We live in a naturally anxious world, so why not have an abiotic being exhibit similar characteristics?

Brief Market Analysis

This product is intended to be sold as a novelty to 30-50 year old "young at heart" individuals with robust senses of humor. The competition is therefore similar to electronic novelty products which present some perceived character or personality (such as the "Leave Me Alone" machine, which, when powered, simply turns itself off). Our product stands out in its unique mode of engagement with the user, offering stress relief in addition to entertainment.

Given that a "Leave Me Alone" machine retails for $10-$30, and given that there is a greater perception of value with a device that can move around the room, it seems reasonable to expect FearBot to sell for $40 per unit. This is not out of line with the price range of a radio-controlled car, which is typically between $50 and $100.

Requirements

When an audible sound, within the human hearing range, is generated near Fear Bot, radially at 10 ft or less, Fear Bot must detect the sound, and should respond by turning in approximately the opposite direction from the noise source and accelerating from standstill to a predetermined speed in under 2 seconds. Fear Bot should accelerate from standstill at a rate that is proportional to the noise perceived
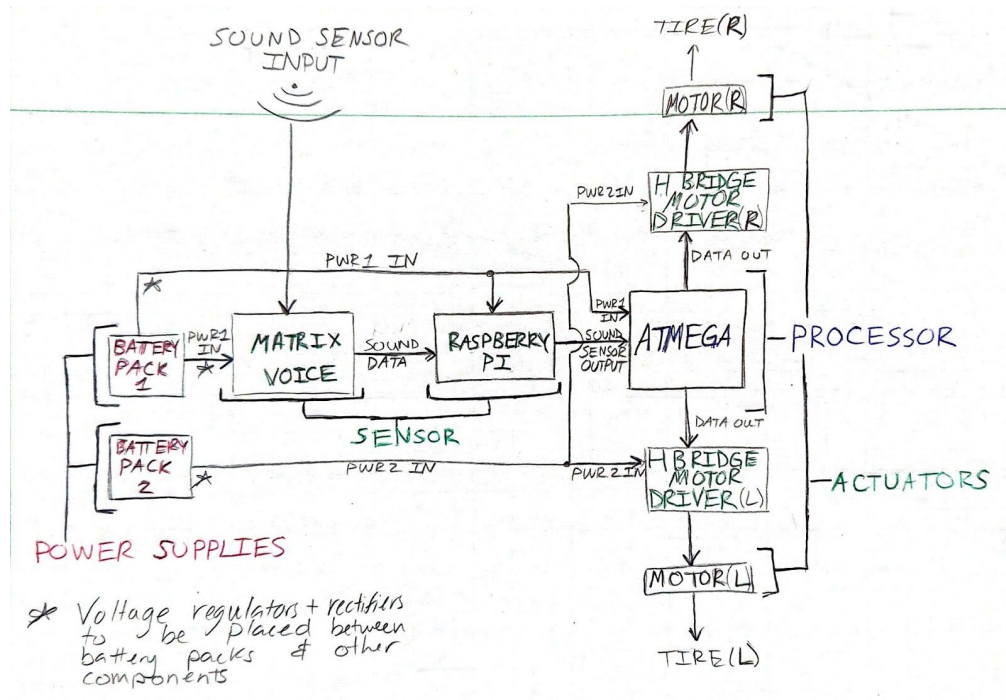
by it. This will translate to a proportional difference in distance travelled from the source, as well. PSU's EPL, Digikey, OSH Park, Tektronix Lab, and other resources that are available should provide the parts, software, and documentation that's necessary to bring this MVP to life.

Minimally, Fear Bot must follow the Practicum Requirements listed below:

○ Have ≥ 1 sensor.
○ Have ≥ 1 actuator.
○ Have a digital or analog processor.
○ Has to be safe.
○ Be in a schematic capture program.
○ Be at least forward annotated with your PCB design.
○ Have ≥ 2 layers, with solder mask and at least a top-side silk screen.
○ Have an area between > 9 cm^2 and < 900 cm^2.
○ Have no linear dimension < 2 cm or > 30 cm.
○ Have the processor on your PCB (i.e., your PCB may not be a "shield" for a processor
  board).
○ Be able to program your processor without removing the processor from the PCB.
○ Have ≥ 25% surface mount components.
○ Be assembled by hand (yes, your hands).
○ Be tested.
○ You will receive 4 PCBs back from manufacturing; at least 1 must work.
○ Have live documentation.
○ Have all documentation and design files under revision control.
○ Use collaborative documentation tools (e.g., Github wiki, Redmine wiki, Google Docs).

System Architecture
Below is a high level block diagram of Fear Bot's electrical system

SOUND SENSOR INPUT

TIRE(R)

MOTOR(R)

H BRIDGE MOTOR DRIVER(R)

PWR2IN

DATA OUT

PWR1 IN

BATTERY PACK 1

PWR1 IN

MATRIX VOICE

SOUND DATA

RASPBERRY PI

PWR1 IN

SOUND SENSOR OUTPUT

ATMEGA

— PROCESSOR

SENSOR

BATTERY PACK 2

PWR2 IN

PWR2 IN

DATA OUT

H BRIDGE MOTOR DRIVER(L)

— ACTUATORS

POWER SUPPLIES

MOTOR(L)

TIRE(L)

✶ Voltage regulators + rectifiers to be placed between battery packs & other components

Design Specification

Fear Bot will be made with the following base parts (other parts will be added as seen fit):

- Sensor: MATRIX Voice paired with a Raspberry Pi 3 board
  - Sound source localization sensor
- Actuator: 2x 3-6V DC Gearbox Motor
- Power: 4xAA Battery Back, 5V 2.1A USB Battery Pack
- Processor: ATMega32U4
- Vehicle frame: Bonatech Smart Car Robot Chassis

- Development Environment: C/C++