2015

IED Disposal Robot

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Project Statement and Objectives

"You can not put a price on human life, so why not replace it with something that can be measured monetarily?"

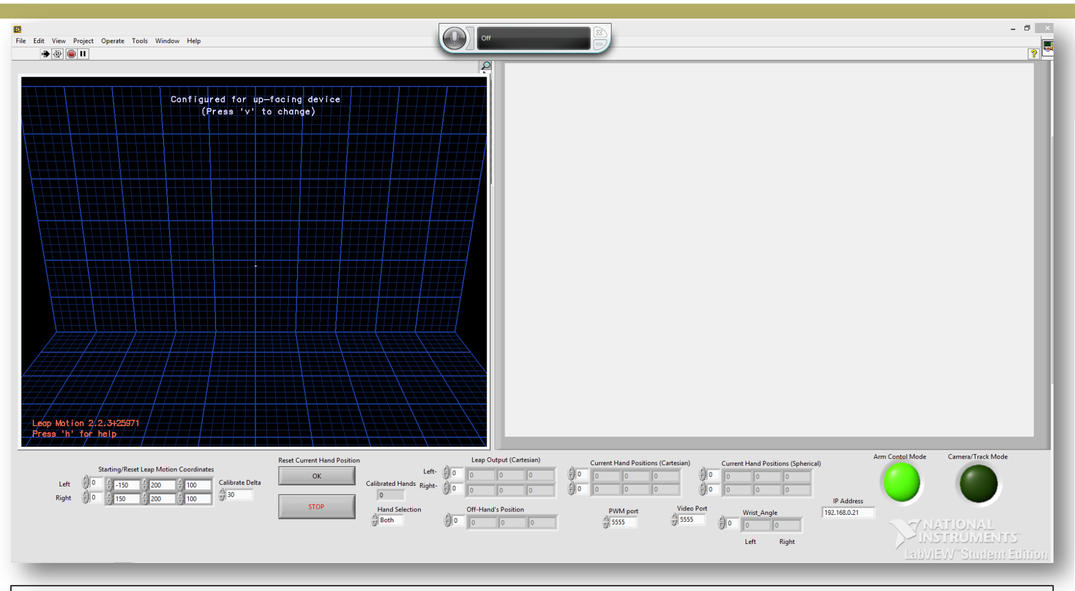
This statement was the inspiration for the development of a low cost un-manned ground vehicle (UGV). Current bomb disposal robots are limited in functionality, high cost, and ease of user operation.

The team devised a cost effective solution that utilized human-like robotic hands that mimic operator gestures. The objectives of the project are outlined as follows:

- Fully Functional UGV
- Mimic Human Gestures
- Lightweight and Rugged
- First Person Camera Feed
- Simple User Interface

General User Interface (GUI)

- Voice control for switching between infrared hand tracking and directional control for the robot.
- Live 720p camera feed at 30 frames per second.
- 3D visualization of hand orientation in free space.
- Direct control of starting hand position and sensitivity to allow for more precise control over hands and tracks..

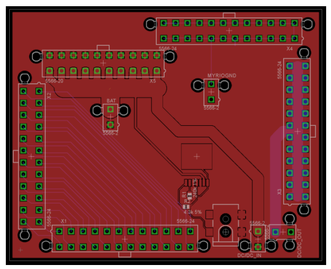


Hand Design

- 3D printed structure with fiberglass reinforcement with 4x40 adjoining stainless steel bolts.
- 6-417 oz/in torque servos that operate at 7.4 volts with digital PWM signal.
  - 1 Servo for rotational wrist movement.
  - 5 Servos for finger control.
- 200lb tensile strength braid attached to servo horn to simulate tendons.
- Reinforced metal skeleton for attachment to linear actuator and potentiometer.

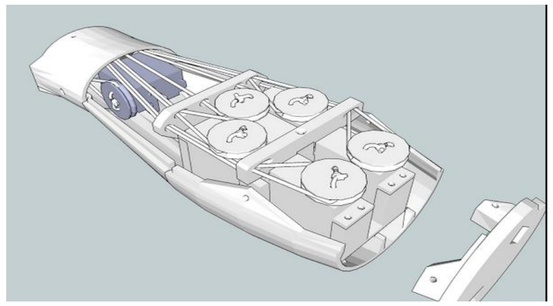
POWER SYSTEM

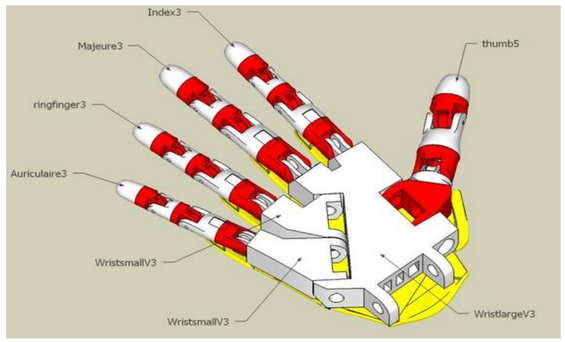
- 2-12 volt 10 amp hour (Ah) nickel-metal hydride (NiMH) batteries connected in parallel to create a 12 volt 20 Ah system.
- Custom designed printed circuit board (PCB) for power distribution between all components.
- A buck DC to DC converter for voltage drop from 12 volts to 7.4 volts.



BASE STRUCTURE

- Base platform is a 1/8 inch thick sheet of 6061 aluminum metal.
- Extruded 2x4 1/8 inch thick aluminum channel to house VDC motors.
  - 4-12VDC 165 RPM 680 oz/in electric motors.
- Custom designed 6061 aluminum arm supports.
  - 4-Torxxis i0600 servos to control arms.
  - 2-12V linear actuators.
  - 2-5V potentiometers for linear actuator feedback.
- Custom independent drive track systems.
  - 4-Aluminum 1.5 inch wide H-Type Timing pullleys to simulate gear wheels.
  - 2-42x1.5 inch wide neoprene timing belts.





CONTROLLER/COMMUNICATIONS

Controller

- National Instruments (NI) myRIO.
  - Programmed with LabVIEW.
  - USB 3.0 Port, Reconfigurable I/O pins.
  - Xilinx Zinc chip.
    - Dual Core A9 built into FPGA.

- The FPGA was configured to generate multiple high precision PWM outputs and implement feedback control system for linear actuators.

Communications

- Through TCP IP links over Wi-Fi, control signals and camera feed are sent from the remote host computer to the myRIO.
  - All signals were flattened to strings to reduce transmission bandwidth.
- User gloves transmit finger control signals over RF via an XBEE constellation.

NORTHROP GRUMMAN

Engineering & Science Student Design Showcase at Florida Institute of Technology