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Smart Tank

Visual SLAM Based Competitive Robot with Object Detection for STEM Education

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Overview

Niches:

- Merely **35%** of UGC-funded undergraduate opted for STEM-related degree programs.
- Hong Kong STEM-related programs **fail** to attract students with the **outstanding** academic achievements.
- Retrieving from a survey by the Federation of Education Workers. **63.6%** of teacher respondents have **no** confidence in teaching STEM subjects.

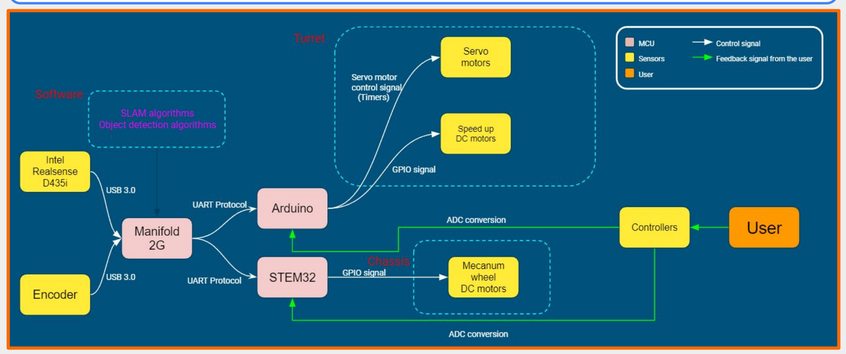
Vision :

To implement a robotic tank for STEM education purposes that allows secondary and college students to gain hands-on experience in robotic design.

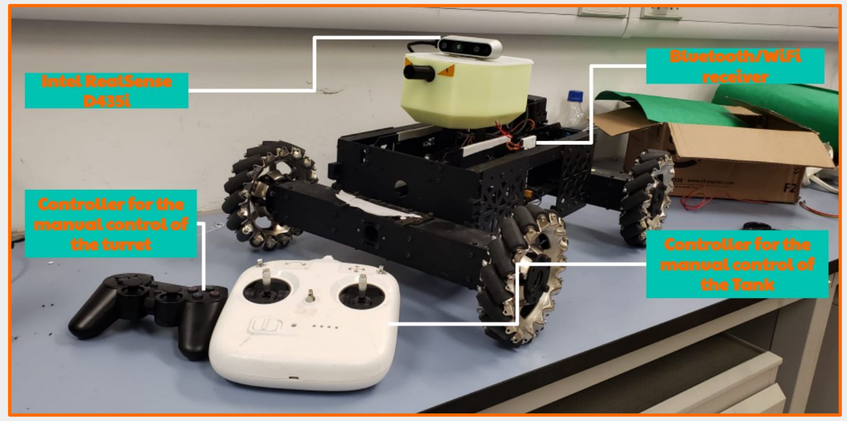
Target Users

- **STEM Teacher**
- **Students**
- **Robot Enthusiast**

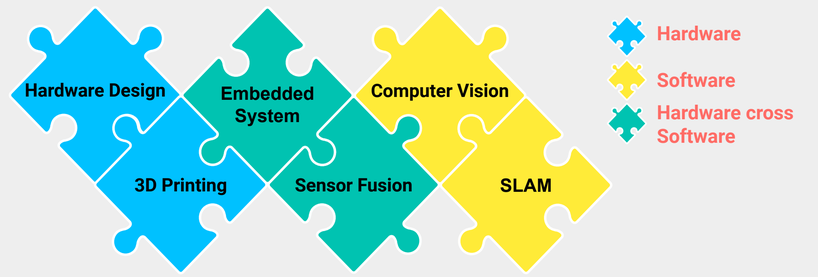
Control Diagram



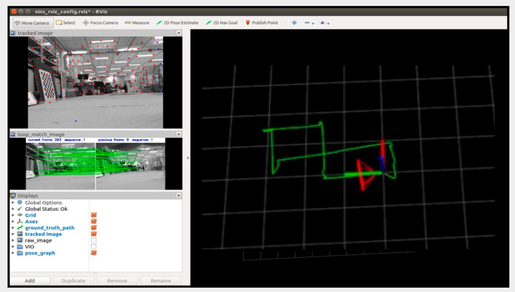
Implementation



The Smart Tank



Results



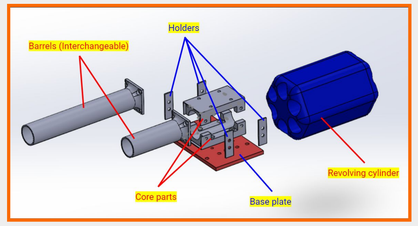
SLAM Result with VINS-Mono

- **High-accuracy visual-inertial odometry**
- **Accurate localization**
- **Accurate state estimation**
- **Exellent performance for feedback control**

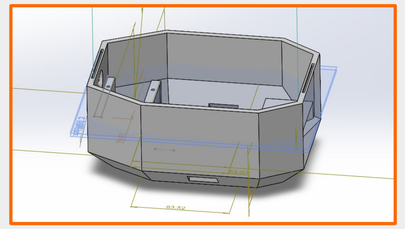
Object Detection Result with YOLO v3

- **High Detection Speed**
  - **Real-time detection at 45 frames per second**
- **High Detection Accuracy**
  - **Training:Validation:Testing = 7:1.5:1.5, and K-Fold Cross Validation**
  - **Average 70% accuracy on detecting tanks and drones**

Technical Details



Shooting and loading module X-Loader v5



Turret case X-Turret Gen3

Hardware

- 3D printed X-Loader v5 & X-Turret Gen3
- DJI Manifold 2-G
- DJI RoboMaster Board A
- Ardiuno UNO
- Intel RealSense D435i
- Controllers & receivers
- Servo motors
- DC motors
- Mecanum wheels

Software

- Ubuntu 18.04
- ROS Kinetic
- ROS Wrapper
- Realsense SDK
- Python 3.6
- Eigen 3.3.3
- OpenCV 3.3.1
- YOLO v3
- VINS-Mono

Conclusion

In summary, we present a visual SLAM based competitive robot with object detection for STEM education called the Smart Tank. Aiming at providing hands-on experience in robotic design to students, a class can split in groups to focus on implementing different parts of the Tank. We validated that the Smart Tank project can cover most subjects including 3D design & printing, embedded systems, computer vision, and SLAM. We will focus on optimizing the appearance design in our future work.