

Colony Scout: A Low-Cost, Versatile Platform for Autonomous Systems in Collaborative Robotics

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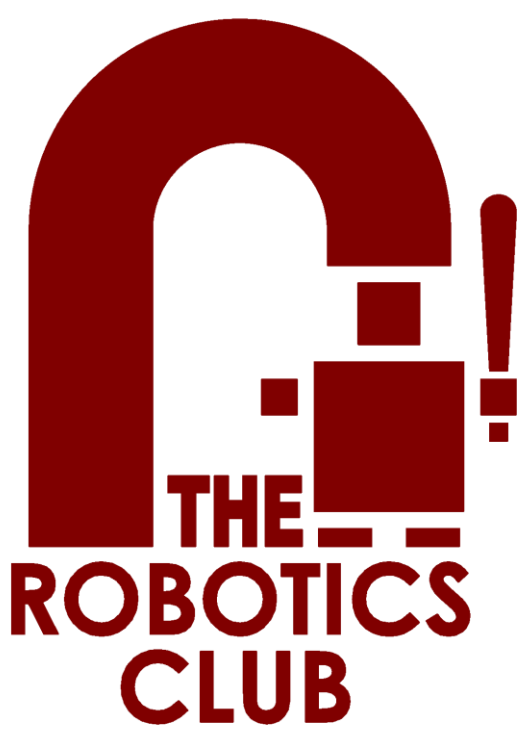
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Robots

The general design of the Colony Scout is a four-wheel drive on a tractor-like base. The front of the robot contains the processing hardware inside a protective hood, while the back of the robot features an expansion bay with free space. A rotating joint between the front and back halves of the robot allows the robot to maintain contact with the ground as it moves over obstacles and rough terrain. Batteries are mounted in the middle of the robot, and a panning sonar array extends above the robot.



Abstract

Cooperative robotics is the concept that a group of robots working as a team can solve problems faster and more efficiently than a single robot. In the past, the Colony Project has explored numerous applications of group robotics, from mapping to formation control to cooperative manipulation. As is the case with a group whose stated goal is to be low-cost, past projects have always been hindered by imprecise sensors, faulty hardware components, and limited mobility. We propose to design and develop a new generation of Colony robots, the Colony Scout, to overcome these obstacles and increase performance, consistency, and robustness. Scout will dramatically improve upon the current generation of robots, Colony 3.0, with an innovative design that includes a more powerful drive system, more capable processing, and more reliable sensors. The main innovations of the Colony Scout will be capability to handle rough terrain and the ability to add new components (for example, a forklift) on an enhancement bay at the back of the robot. With more reliable and capable hardware, the Colony Project hopes to embark on more ambitious projects than in the past and to contribute in a more significant way to swarm robotics research.

Sensors

Designed to perform collaborative task in unknown environments, Colony Scout has the following sensors to assist its performance:

Primary Distance Sensor

- narrow-beam ultrasonic rangefinder
- panning design, allows 360-degree visibility and environment mapping
- more reliable and accurate

Cliff sensors

- shorter-range range sensor oriented downward
- allow the robot to detect sudden drops in height

Mutual detection Sensors

- four emitter-detector pairs encoding robot ID and orientation
- allow robots to know their relative positions and pose

Accessories

The scout platform promotes modularity and growth using an expansion bay, which features hard mounts for accessory attachment, and power and data connectors.

Types of Accessories:

- Forklift
- Digging Arm
- Wagon
- Item Dispenser

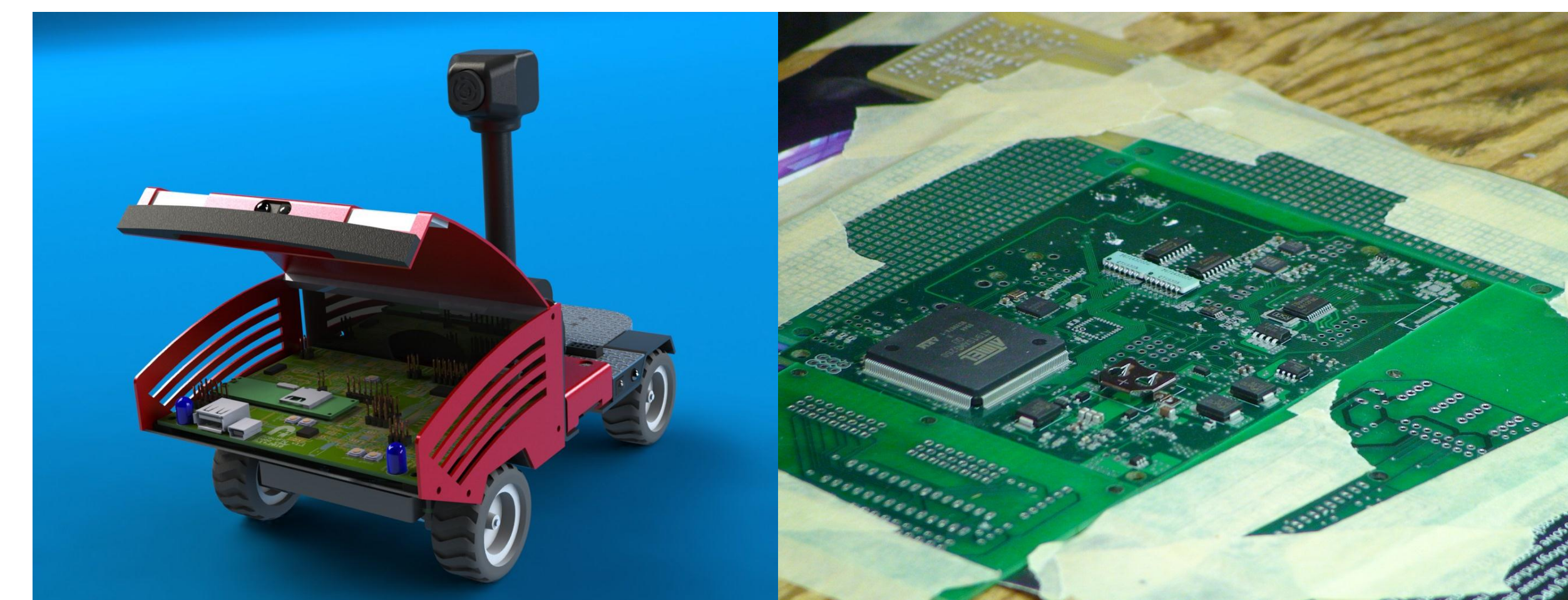


Board

The Scout is controlled by a custom designed 4 layer circuit board.

Features:

- Houses Gumstix and AVR to provide connectivity
- Switching power supply that provides regulated 5V and 3.3V
- USB host capability



Computer Systems

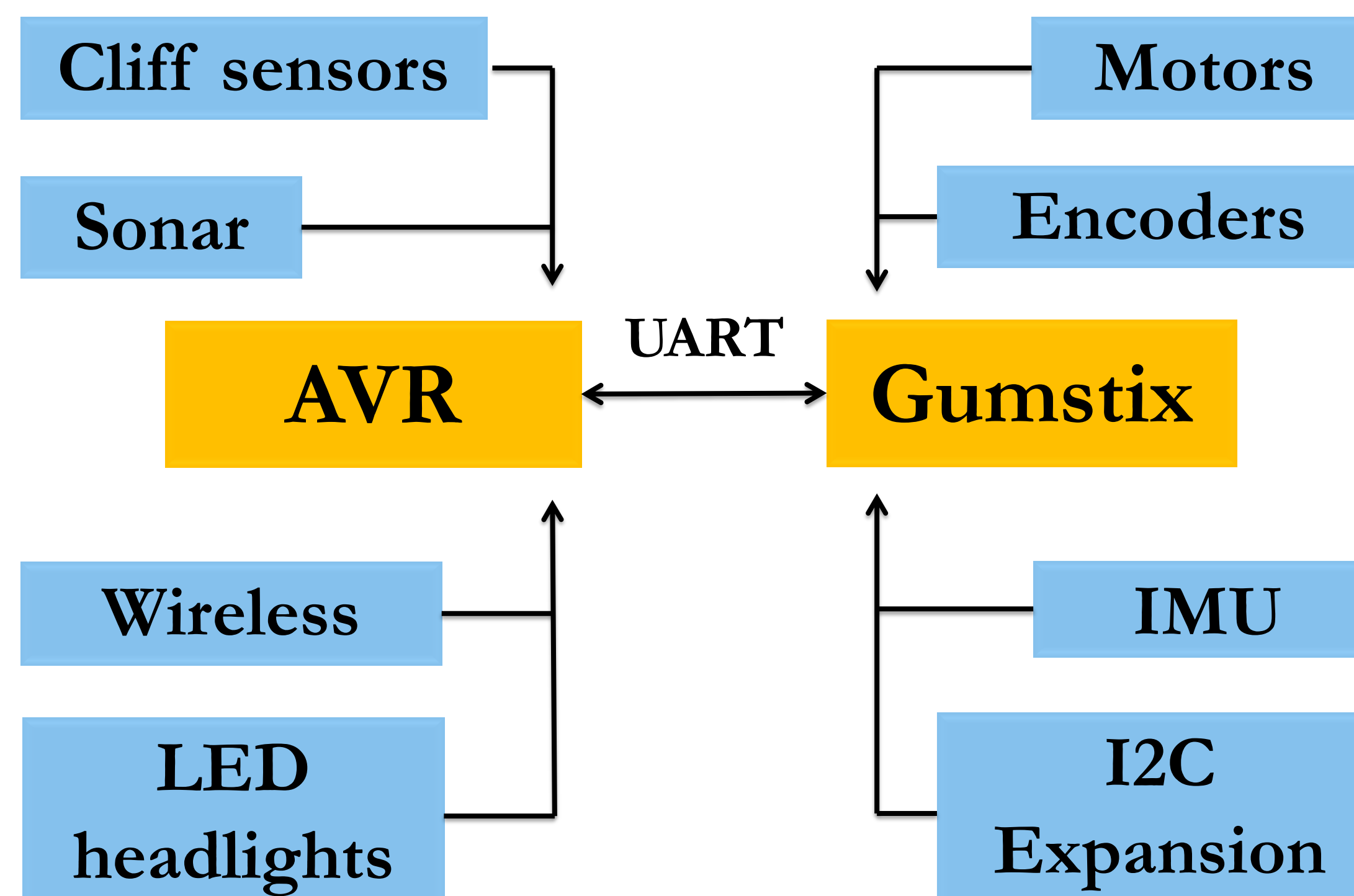
The scout robots feature two processing units: a Gumstix microcomputer running GNU/Linux and an AVR microcontroller running custom code.

AVR microcontroller

- Low-level tasks: polling sensors, wireless communication

Gumstix microcomputer

- Users can program in multiple languages
- ROS publisher/subscriber method makes code modularity easier



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