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IT Convergence

LiDAR STEERING SmartCAR

LiDAR STEERING SmartCAR is a moving robot equipped with LiDAR sensor and steering system. It is a training device for learning about LiDAR, various sensors, autonomous driving, ROS and SLAM.

ARDUINO

Since 1984

IT Convergence

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- Adopts Arduino, an open hardware platform for controlling robot sub-systems such as motors and sensors
- LiDAR sensor configuration for autonomous driving
- Robot Operating System (ROS) training, a robot middleware
- Simultaneous localization and mapping (SLAM) training
- Obstacle detection using multi-ultrasonic sensor
- Speed Measurement with LiDAR
- Line tracer drive using infrared sensor
- Control of driving part operation using DC Encoder Motor
- Steering Control of Driving Part using Servo Motor
- Providing Java-based OpenCV solution to utilize Android for vision robot research
- Intelligent control using Accelerometer, Gyroscope sensor
- Using smartphones and tablets as robots' brains
- Provide AndroX Studio™ integrated development environment for robotic system service development

Product Overview

LiDAR STEERING SmartCAR is developed to support the research of ICT convergence service using intelligent mobile robot and the training of high value human resources. With LiDAR Sensor and Steering System, it is educational device to learn about LiDAR, various sensor, autonomous driving, ROS (robot operating system) and SLAM (Simultaneous localization and mapping).

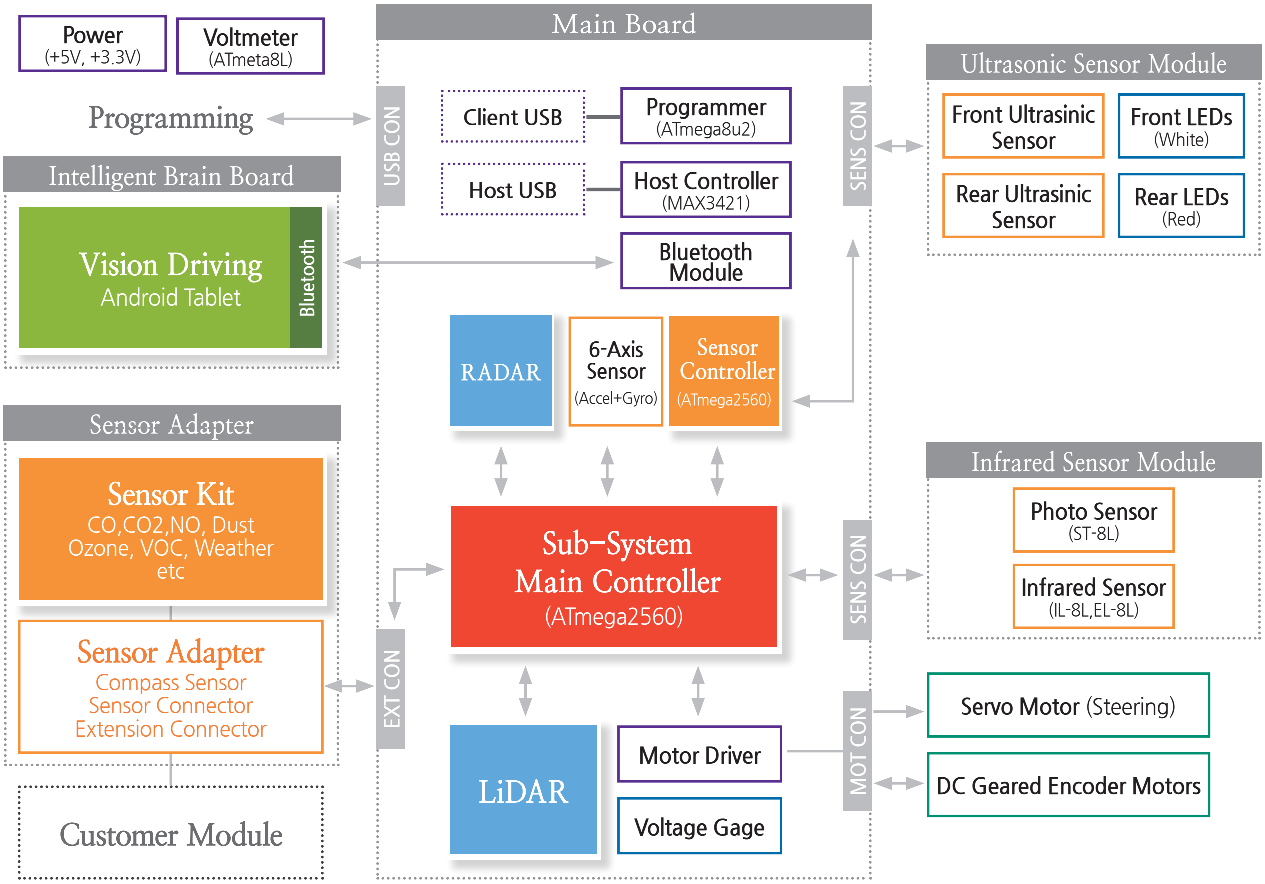
Designed to enable smart phone and PC to be used as robots' brains for high-performance vision processing, it combines data from acceleration, magnetic, and gyroscope sensors with vision, including 12 ultrasonic sensors and 8 infrared sensors, It can be used to develop innovative autonomous navigation algorithms and application services for mobile robots.

Product Features

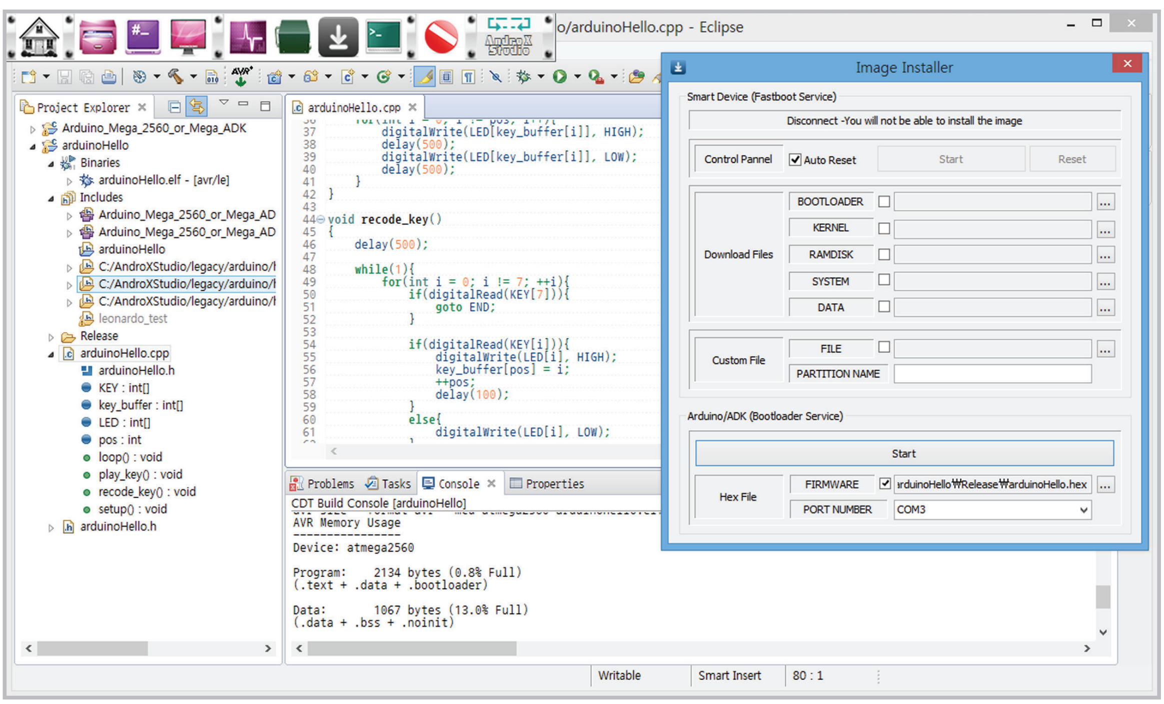
- This is a moving robot with an autonomous LiDAR sensor. It contains examples of collision avoidance and examples of position tracking, so you can learn about ROS and SLAM.
- With the integrated development environment, anyone can easily and quickly implement firmware for electronic device control. The Arduino integrated development environment is based on the environment using processing / wiring language which is effective for developing interactive objects, easy operation of microcontroller, and easy programming via USB.
- By supporting the ADK-based electronic device development environment, the Google Smart Device Peripheral Design Platform, you can quickly and easily develop applications that work with Smart Devices with the Google Android platform.
- With 12 ultrasonic sensors and 8 infrared sensors, obstacles can be avoided and missions can be performed on a given route.
- By incorporating acceleration and gyroscope sensors, it is possible to develop intelligent robots that autonomously travel by detecting and judging the acceleration, vibration, shock and motion information of the robot by itself.
- DC geared motor has built-in encoder, so it can detect the operation status of motor and can calculate rotation direction and speed.
- Accurate steering control using servo motor is possible and it is able to change the rotation axis of front wheel for forward direction.
- Built-in Bluetooth communication module enables remote control based on SPP profile through PC, notebook, smartphone, tablet etc. that support Bluetooth communication

  Smart phones and tablets can be used as the brain of mobile robots, enabling the implementation of mobile
- robot-based ICT convergence services using high-performance processors and Wi-Fi communication environments provided by smartphones and tablets.
- We provide AndroX Studio™, an integrated development environment for Android-based robot image processing and high-end service development.

Block Diagram



Integrated Development Environment AndroX Studio™



Configuration and Name

LiDAR STEERING SmartCAR

Hardware Specifications

Category	Specification
Main Body	
Size	340mm x 600mm x 220mm
Weight	6Kg
Sub-System Main Controller	
Controller	ATmega2560 (Google ADK Platform with Arduino Mega2560)
Driving Clock	16MHz
Flash Memory	256 KB
EFPROM Memory	4 KB
SRAM Memory	8 KB
ADC	10bit 16Channel
USB Host Controller	MAX3421E USB 2.0 With SPI Bus
Buzzer	5V Sound Pressure Level: 88 dB
Connectivity	
Bluetooth	On-Board Bluetooth (FB155BC)
	v2.0+EDR
	SPP, A2DP, HSP
Sensor Controller	
Controller	ATmega128
Driving Clock	7.3278MHz
Flash Memory	128 KB
EFPROM Memory	4 KB
SRAM Memory	4 KB
Ultrasonic Tx Sensor	MA40S4S (40KHz / 20 Vp-p) 12EA
Ultrasonic Rx Sensor	MA40S4R (40KHz / 20 Vp-p) 12EA
Infrared Sensors	
Light Emitter	3mm, 940nm Infrared Emitter Diode 8EA
Receiver	3mm, Photo Transistor 8EA
6-Axis Physical Sensors	
Acceleration, Gyroscope Sensor	MPU-6050
	3-Axis MEMS Gyroscope
	3-Axis MEMS Accelerometer
Motor	
DC Motor	12V DC Geared Encoder
Servo Motor	5kg/cm at 6V, 0.14 sec/0.12sec 4.8V/6V
Motor Driver	L298P
Digital Voltmeter	
Controller	ATmega8
Display	3Digit 7-segment

Category	Specification
Programmer	
USB Controller	ATmega8U2 16MHz (include bootloader)
Interface	Programed as USB-to-Serial converter with DFU mode
External Interface	
USB Host	USB 2.0 1Port
USB B type Port	B Type USB 1Port
Expansion Port	2x10 Header 2EA (Power, I^2C, UART 2Port, GPIO)
Sensor Adaptor	
3-Axis Compass Sensor	AK8975C
	3-Axis Electronic Compass
Sensor Connector	2x25 1.27mm Pitch Header
Expansion Connector	UART 1Port, GPIO 5EA, Power(3.3v, 5v, 12v)
Power	
Battery	NionH Battery 2400mA 8.4 Volts

RADAR Specification

Parameter	Notes	Min	Typical	Max	Units
Frequency Setting	1	10.520	10.525	10.530	GHz
Radiated Power (EIRP)	1	12	15	20	dBM
Spurious Emission	1			-7.3	dBM
Settling time			3	6	µSec
Received Signal Strength	2		200		µVp-p
Noise	3			5	µVrms
Antenna Beam-width (3 db) - Azimuth			80		°
Antenna Beam-width (3 db) - Elevation			40		°
Supply Voltage		4.75	5.00	5.25	VDC
Current Consumption			30	40	mA
Pulse Repetition Frequency	4		2		KHz
Pulse Width	4	10			µSec
Operating Temperature		-15		55	˚C
Weight			8		gm

LiDAR Specification

Item	Unit	Min	Typical	Max	Comments
Distance Range	Meter(m)	TBD	0.15 - 6	TBD	White objects
Angular Range	Degree	n/a	0-360	n/a	
Distance Resolution	mm	n/a	<0.5 <1% of the distance	n/a	<1.5 meters All distance range*
Angular Resolution	Degree	n/a	≤1	n/a	5.5Hz scan rate
Sample Duration	Millisecond(ms)	n/a	0.5	n/a	
Sample Frequency	Hz	n/a	≥2000	2010	
Scan Rate	Hz	1	5.5	10	Typical value is measured when LiDAR takes 360 samples per scan

Software Specifications

Category	Specification
Robot Subsystem Arduino Firmware	
Arduino Integrated Development Environment	AndroX Studio™, Arduino IDE, ArduBlock
User Library	Arduino Private Library by Hanback Electronics
Functional Test Firmware	Motor / Encoder, Ultrasonic Sensor, Infrared Sensor, LED, Compass Sensor, Gyro Sensor, Accelerometer, Buzzer, UART / Bluetooth
Intelligent Robot Test Firmware	Remote Control between Smart Device and HBE-SmartCAR based on Bluetooth Automatic Obstacle Avoidance using Ultrasonic Sensor Autonomous Driving that Recognizes Objects using Vision Specified Route Driving using Infrared Sensor Specified Route Driving using Encoder, Acceleration, Gyro Sensor
Robot System Vision / Service Program	
Smart Device Integrated Development Environment	AndroX Studio™
Vision Library	OpenCV for Android
Vision Application	YUV to RGB Conversion, Pixel based Image Processing, Mask based Image Processing, Color Recognition, Feature Recognition, Face Recognition, Motion Recognition
Smart Device Applications	HBE-SmartCAR Sensor Value Reception and Direction Remote Control Obstacle Avoidance Autonomous Driving Remote Monitor using Ultrasonic Sensor Object Recognition Autonomous Driving Monitor using Vision Specified Route Driving Monitor with Infrared Sensor Specified Route Driving Monitor with Encoder, Acceleration, Gyro Sensor Wi-Fi based Smart Device Video Real-time Reception

ROS

Robot Operating System (ROS) is robotics middleware (i.e. collection of software frameworks for robot software development). Although ROS is not an operating system, it provides services designed for heterogeneous computer cluster such as hardware abstraction, low-level device control, implementation of commonly used functionality, message-passing between processes, and package management.

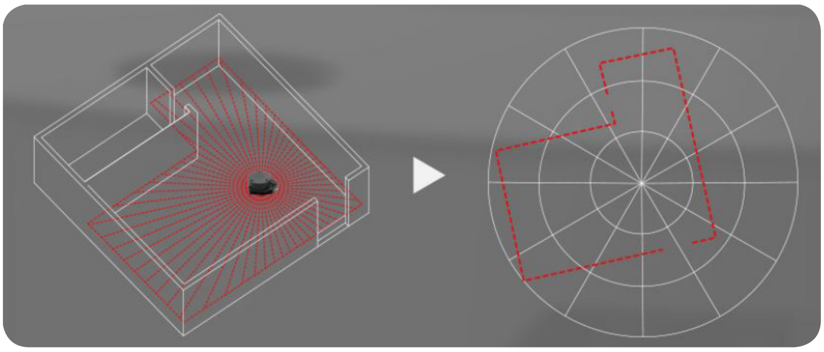
SLAM

Simultaneous Localization and Mapping (SLAM) is a concept used in robotics and so on. It is a technology that the mobile robot moves around in arbitrary space, searches for the surrounding area, and maps the space and estimates the current position.

LiDAR

You can create digital 2D or 3D representations of objects using reflection time and wavelength differences by measuring the distance and shape to the object based on reflected pulses using infrared light.

12 meters	8000 Se / s	1* Degree	0.2** cm	5 Volt
Detection Range	Sample Rate	Angular Res.	Distance Res.	Power Supply



LiDAR SmartCAR Configuration

CAMERA
The most cost-effective type of sensor. Camera data is very good for detecting the texture and color of lane markings, signs and traffic lights.

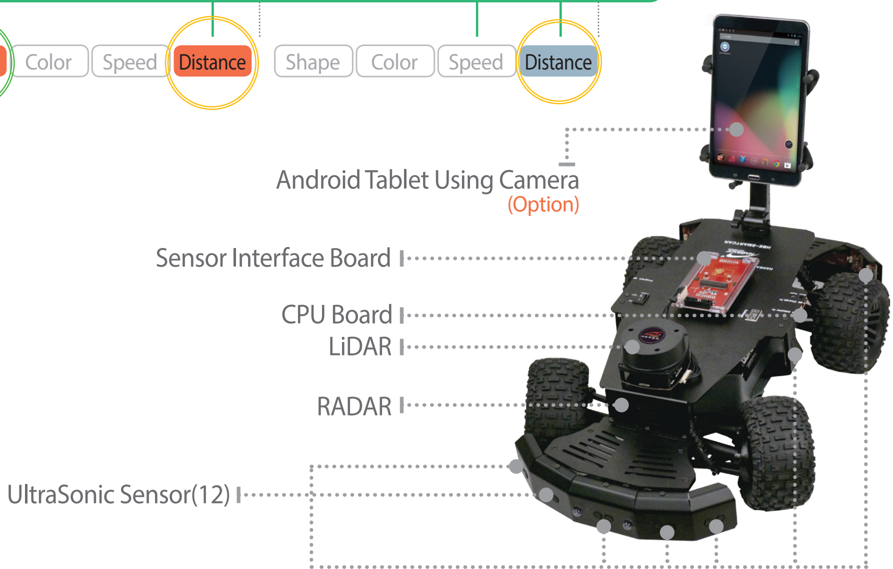
LIDAR
A laser-based sensor that can accurately detect the shapes of cars, pedestrians, curves, undrivable areas and other structures.

ULTRASONIC
Detects the position of the obstacle. Uses ultrasonic waves to determine the distance to obstacles.

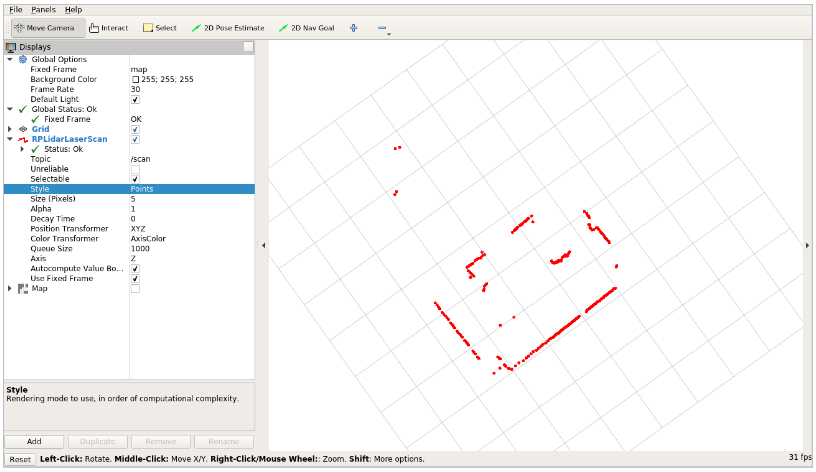
CPU
Analyzes LiDAR and other sensors using the ATmega2560 CPU board and performs autonomous operation.

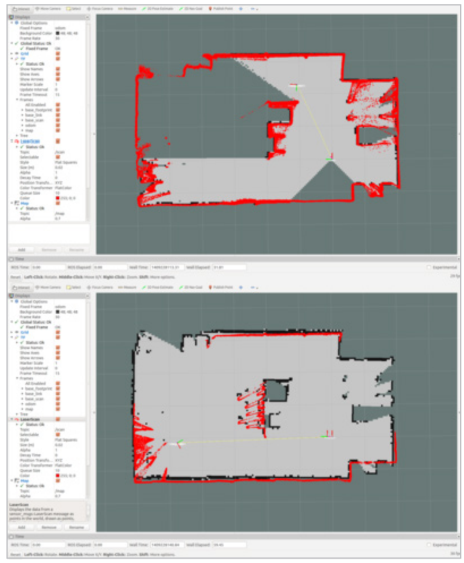
Data collected by sensors

Shape Color Speed Distance | Shape Color Speed Distance | Shape Color Speed Distance

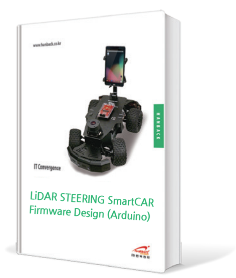


ROS / SLAM Driving Screen





Training Contents

Teaching Material	Textbook Index
	**LiDAR STEERING SmartCAR Firmware Design (Arduino)** - Overview of Mobile Robot - Characteristics and Control Method of Motor - Understanding Processor AVR for Mobile Robot - LED Control of Mobile Robot (SmartCAR) - Mobile Robot Remote Control through UART - Control of Wheel Rotation of Mobile Robot - Movement Direction Steering Control of Mobile Robot - Mobile Robot Speed Control using PID Control - Robot Posture Recognition using 6 Axis Sensor (MPU-6050) - Line-Tracer Implementation using Infrared Sensor - Autonomous Driving using Ultrasonic Sensor - Geomagnetic Measurement using Compass Sensor - LiDAR Overview and Description - LiDAR STEERING SmartCar Autonomous Driving - ROS Programming - ROOM Mapping with LiDAR Sensor
	**LiDAR STEERING SmartCAR Control and Vision App Design (Android)** - HBE-SmartCAR Control - Android Camera Control - OpenCV-based Camera Image Processing - LiDAR STEERING SmartCAR Control with Camera Image Processing - Wi-Fi based Camera Video Transmission

Textbook Chapter

Chapter 1. Overview of Mobile Robot
Chapter 2. Motor Characteristics and Control Methods
Chapter 3. Understanding Processor AVR for Mobile Robot
Chapter 4. LED Control of Mobile Robot
- Control using GPIO and Timer

Chapter 5. Remote Control of Mobile Robot by UART
- LED and Buzzer Control using UART Communication

Chapter 6. Steering and Moving Control of Mobile Robot
- DC Motor Characteristics and Operation Method
- How to Operate the Encoder
- Servo Motor Characteristics and Operation Method

Chapter 7. Recognition of Robot Position using 9 Axis Sensor
Chapter 8. Speed Measurement with RADAR
Chapter 9. Line-Tracer Implementation of Infrared Sensor
Chapter 10. Autonomous Driving using Ultrasonic Sensor
Chapter 11. Geomagnetic Measurement with Compass Sensor
Chapter 12. LiDAR Overview and Description
Chapter 13. Autonomous Driving with LiDAR Sensor
Chapter 14. ROS Programming
Chapter 15. ROOM Mapping with LiDAR Sensor

IT Convergence _ SmartCAR Series

SmartCAR

Intelligent Mobile
Robot Platform

SmartCAR **MECANUM WHEELS**

Intelligent Mobile
Robot Platform
with Mecanum Wheel

LiDAR SmartCAR

Autonomous Driving
Robot Platform
using LiDAR Sensor

LiDAR STEERING SmartCAR

Autonomous Driving / Steering
Robot Platform
using LiDAR, RADAR Sensor

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LiDAR STEERING SmartCAR

Since **1984**

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