# Autonomous NavigaTor (ANT)

a GPS based autonomous vehicle

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# Abstract

Autonomous NavigaTor or ANT as the name suggests is a self driven vehicle. It is designed to move from one location to other guided by variety of sensors. These include GPS, Sonar and Bump sensors. The short term objective of this project is to move from one place to another but later on as its range and accuracy is increased it can be used to guide people from one place to another or on larger scale it can be used in creating driverless cars.

The objectives of the project are as follows:

1. Build a platform which is rugged enough to move over varied terrain such as roads, grass.
2. Integrate sonar and bump sensors with the platform so that ANT can exhibit basic obstacle avoidance. This behavior will provide foundation to the final goal of the project.
3. Integrate GPS sensor to the robot so that it is cognizant of its current location and destination so as to reach its target using the best available path.
4. Build a platform which is rugged enough to move over varied terrain such as roads, grass.
5. Integrate sonar and bump sensors with the platform so that ANT can exhibit basic obstacle avoidance. This behavior will provide foundation to the final goal of the project.
6. Integrate GPS sensor to the robot so that it is cognizant of its current location and destination so as to reach its target using the best available path.

# Executive Summary

ANT is an ambitious project as everyone working on this architecture has got limited success, reason being inherent inaccuracy of GPS system and noise/interference while using obstacle avoidance sensors. Normal accuracy rate of GPS is around 15 meters. This means the current position provided by GPS sensor can be anywhere between 0-15 m. I plan to overcome this by using odometer and add error handling in program itself. Also if I have sufficient time and resources I will go for differential GPS which will further enhance the accuracy of GPS system. As I am on initial stage of building the project I have not finalized the platform and type of sensors and motors which I shall use during the course of development of this project.

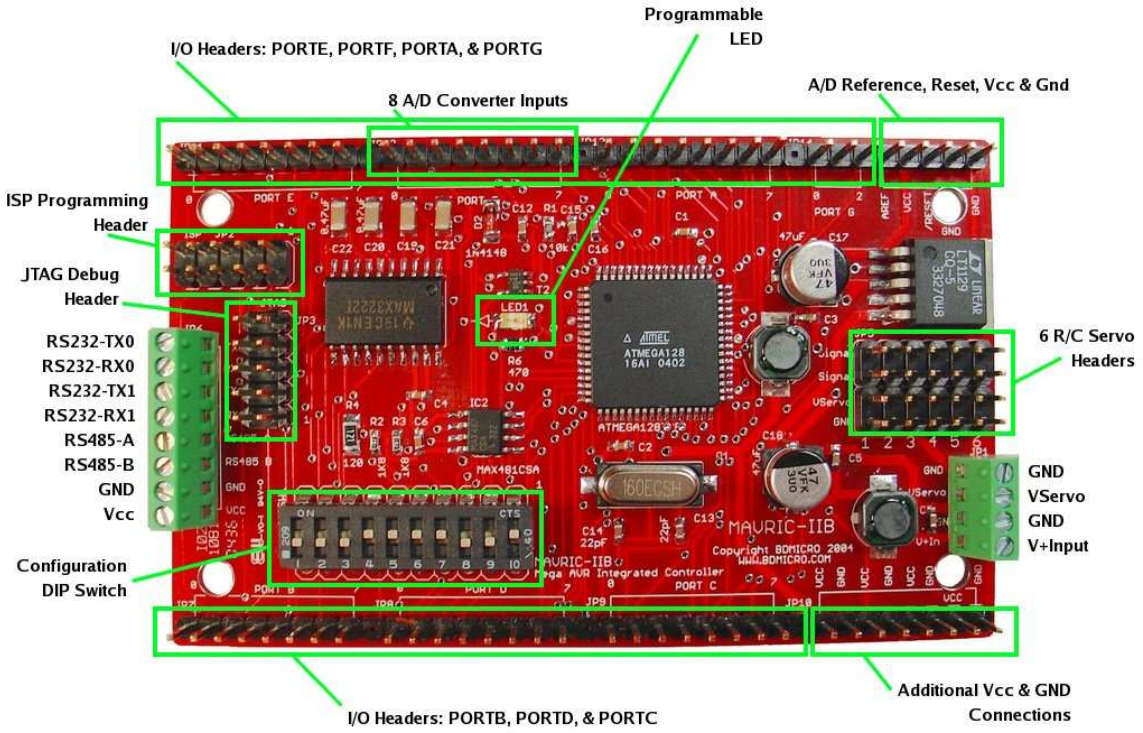
Before moving ANT will be connected to a computer from where it will receive the directions to its destination. The instructions will be GPS co-ordinates of its destination and the path which it will follow for reaching its destination. These directions can be received from Google maps or similar tool. Then ANT is switched to drive mode and it follows the path to its destination. When it encounters an obstacle in its path, ANT will slow down and scan the area immediate to where obstacle is detected. ANT will then steer left/right depending upon the situation to bypass the obstacle and reach its target.

# Introduction

The main focus of this project is to develop a robot which can autonomously travel from one place to another, avoiding obstacles. To handle navigation, Global Positioning System (GPS) will be used. GPS is a system of 24 satellites which transmit position signals to earth. A GPS receiver uses data from 3 to 12 of these satellites to figure its exact location. Due to atmospheric conditions and other factors, the error in data received from GPS sensor has an error of 10 meters. SRF ultrasonic sensors have range of 4 meters i.e. they can detect an object from a distance of 4 meters. I will be using 2 sensors so as to minimize the error in readings due to noise and interference. LCD display will show errors, the path to follow and other information. All the equipment will be fitted on a custom built platform which will be in the form of four wheel car. A DC motor wheel power the front wheels and it will be steered using a servo.

# Integrated System

ANT will be fitted with a GPS sensor (I am planning to use 20 Channel EM-406A SiRF III Receiver with Antenna for that) and for obstacle avoidance two SRF05 sonar sensors will be used. The last point of detecting obstacle would be bump sensor located on front of the vehicle which will detect any direct contact. This will be fitted on custom built platform which will be run by DC motors. There will be a LCD display which will show the decisions being take by ANT. The brain of ANT will be a MAVRIK-II B. MAVRIC-IIB is a powerful microcontroller board based on the ATmega128 MCU. It is fully programmable using familiar languages such as C and BASIC.



# Mobile Platform

ANT will be a four wheel robot with front wheel drive. The steering and braking system will be connected to front wheels. It will be driven by a powerful DC motor connected to front wheels. Steering will be done using a servo. I am planning to use custom built platform for running ANT. Initially it will be made of wood but later on I will move it to aluminum base due to light weight, sturdiness and durability of aluminum.

# Actuation

I have not finalized what kind of motors or gear system I will use to drive ANT. But it will be a front wheel drive.

# Sensors

## GPS Sensor:

The EM-406A GPS module from USGlobalSat is based on SiRF StarIII chipset. This complete module includes on-board voltage regulation, LED status indicator, battery backed RAM, and a built-in patch antenna.

**EM-406A SiRF III Receiver**

## SRF05 Sonar Sensor:

Since the robot will be running outdoors, light levels will be too high for IR to be of any use. Also, the useful distance of IR is less than 2 feet, which would be inadequate for the speeds at which the robot will be traveling. So, sonar has been chosen for object detection. This is the low-cost successor to the SRF04 detector. It includes a LED status indicator that blinks when the sonar fires as well as a new single-wire mode of operation. It has a range of 3cm – 4m.

**SRF05 Sonar Sensor**

## Bump Switches

To provide basic collision detection, bump switches will be connected to the front bumper to detect when an object is hit.

# Behavior

ANT will begin by determining its target coordinates and path to follow from computer. Then it will follow the destined route to reach its target. Once it is moving the sonar constantly checks for obstacles in its way. If there is something within 5 to 15 feet, ANT will slow down. If there is something within 3 feet in front of ANT, it will stop, scan the vicinity and determine the best route around the obstacle. ANT stores the co-ordinates of the path which it needs to follow on onboard memory and it compares its current position to calculate the route it needs to take to reach destination.