Howard University
Electrical and Computer Engineering Department

SENIOR DESIGN PROJECT 2008/2009
DESIGN PROPOSAL

Autonomous Map Follower

TEAM MEMBERS

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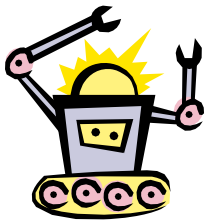
Overview

- Introduction
- Problem Formulation
- Current Status of Art
- Overview of Solutions
  - Proposed Solution
  - Alternate Solutions
- Project Management
- Deliverables
- Cost and Resources
- Conclusion

Introduction



- The objective of this project is to design a system that allows a vehicle to drive autonomously from one destination to another
- By replacing the human driver with a system that can autonomously drive the vehicle, it is likely that driving can be made safer for both commuters and pedestrians.
- The team will deliver a scaled version of the prototype which will mirror the full functionality of the design

Problem Formulation

What is the problem?

What are the constraints?

Problem Formulation cont'd.

The Autonomous Vehicle System Should:

- Calculate and drive a route
- Stop at destination within 5% error margin
- Alert the user upon arrival at destination
- Allow the user to abort on-going destination navigation

Problem Formulation cont'd.

Additional Requirements

- Change desired destination during on-going navigation
- Automatically calculate and return to departure location
- Stop at destinations along the original destination route
- Turn off remotely

Current Status of Art

GPS

- Strength- With GPS it is proven that the idea of an autonomous car can follow a map and reach its destination. i.e. DARPA
- Weakness- The map follower could not be an independent part of the vehicle and it must be integrated with other components in the vehicle for it to successfully drive autonomously from a start destination to a final destination.

Electric Compass

- Strength- When the external interferences are eliminated the electric compass becomes more accurate with navigation.
- Weakness- Sensitivity to external interferences of the magnetic field, the electric compass itself is not accurate enough to be used for localization

Multilateration

- Strength- It is commonly used in civil and military surveillance applications to accurately locate an aircraft, vehicle or stationary emitter.
- Weakness- Integrating it with software to help navigate the vehicle instead of locate or track it.

Overview of Solutions

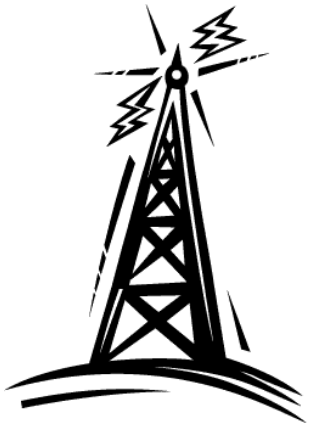
- GPS Driven Controller
- RF transponder and Communicating Towers
- Manual User Input

Proposed Solution

- Contains a computer, and two microcontrollers.
- One microcontroller in charge of receiving, interpreting GPS signal
- The computer will be the core part of the system that will interpret, plan, translate given instructions
- The final microcontroller will be in charge of the motors and will move the vehicle.

Alternative Solution 1

- Minimum of three towers for Multilateration to be effective
- Using an RF transponder communicating with signals emitted from multiple towers or locations, through a route
- Route predetermined by the user.



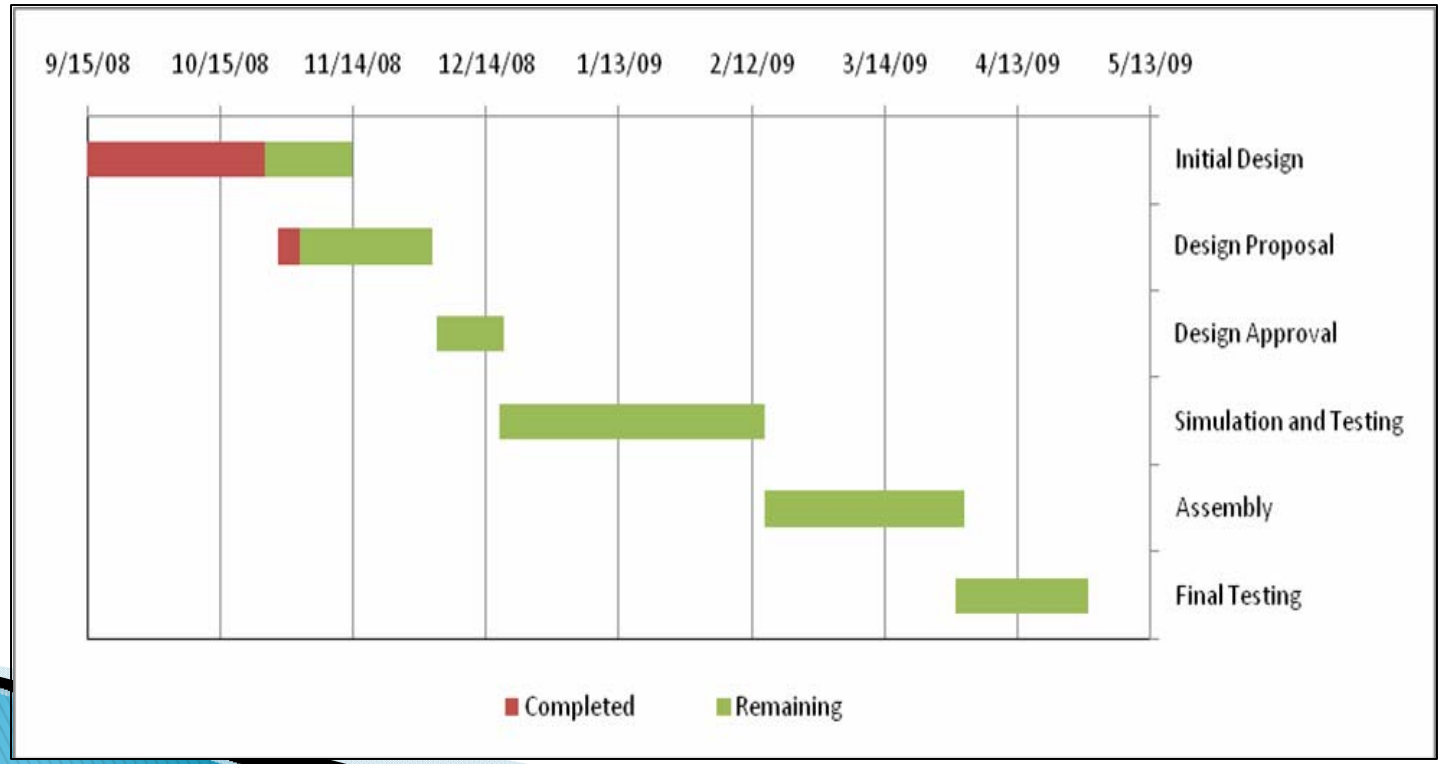
Alternative Solution 2

- User inputs line by line directions

- Sent to a central processing unit which will be connected to an electric compass
- System requires the user to know the exact position of their starting point, as well as their ending point

Project Management

- The project will span approximately 8 months and tasks will be completed following the set timeline



Deliverables

- Fully functional prototype of system integrated with a scaled auto vehicle.
- The system will be demonstrated at the ECE Senior Design presentation day
- Manual which will include operating instructions as well as tips for troubleshooting any problems encountered in operating the system

Costs and Resources

- An estimated budget of about $1500 will be required in developing and testing a scaled prototype of the autonomous map follower system
  - GPS System: $200
  - GPS Expansion Pack: $60
  - 32 bit PIC microcontroller start kit: $60
  - MPLAB C Compiler for PIC24 MCU: $500
  - MatLab with Simulink: $100
  - Lego Mindstorm NXT: $250
  - Miscellaneous: $300

- Facilities which will be utilized include the Mobile Studio Lab, FPGA boards, as well as other testing equipment in the Electrical Engineering Lab

Conclusion

- The project will develop and build a system which allows a vehicle to autonomously navigate from one point to a determined destination
- A key part of the system will be in utilizing an effective technology in accurately keeping the vehicle on track for its destination
- A scaled version of the design solution will be completed within 8 months, and the total design and implementation will cost approximately $1500.

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