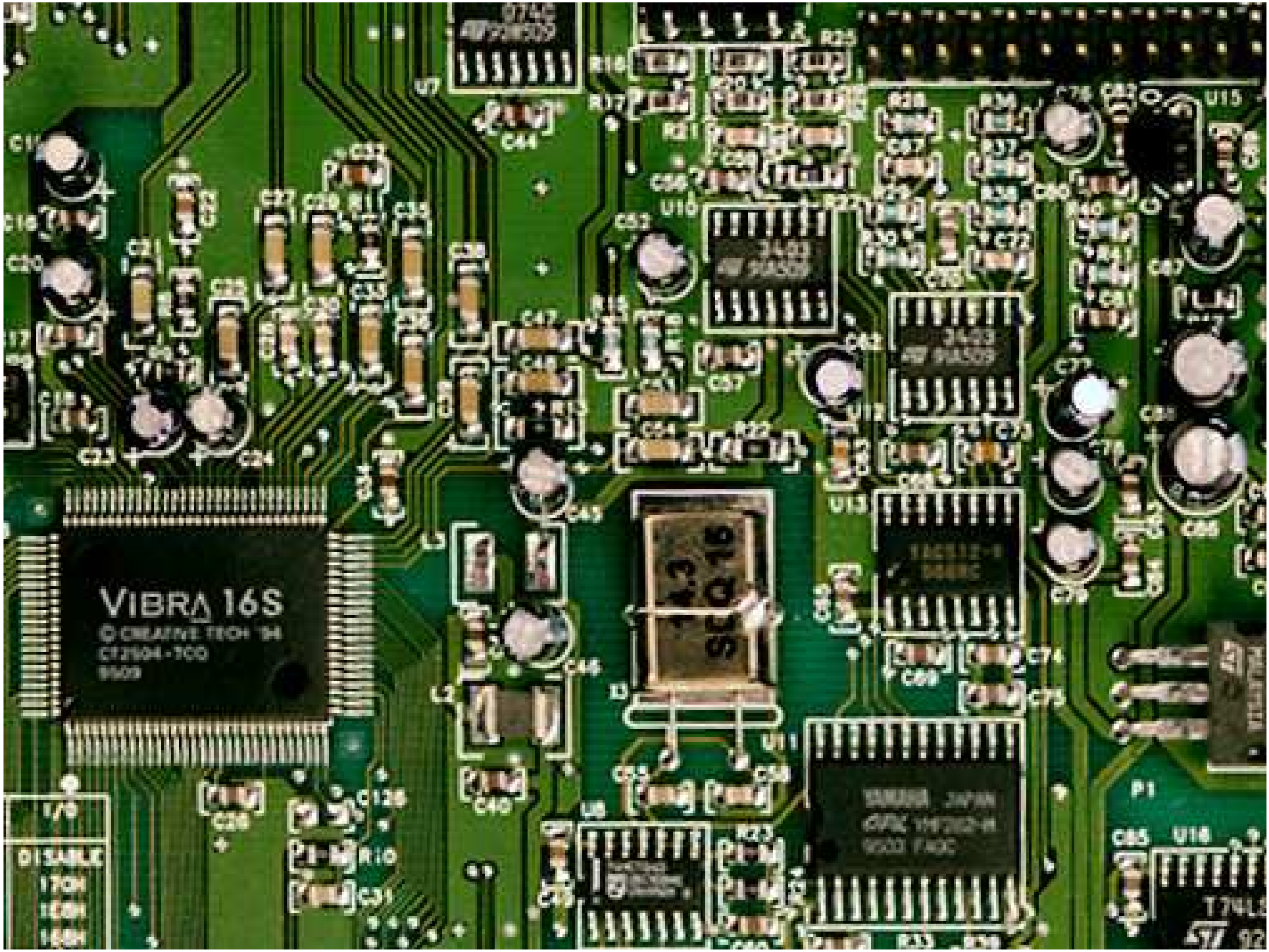

VIBRA 16S
© CREATIVE TECH '94
CT7504-TCQ
9603

# Truck Loading Using an Autonomous End-Loader

Senior Project Fall 2008

Kevin Hurley

Ryan Leman

Bradley University

EE 451: Senior Laboratory

Advisor: Dr. Schertz

# Overview

- Introduction
- Overall System Block Diagram
- Vehicle
- Truck and Pile Sensors
- Bucket Tilt/Position Sensors
- Distance Sensors
- Velocity Sensor
- Software
- Task Schedule

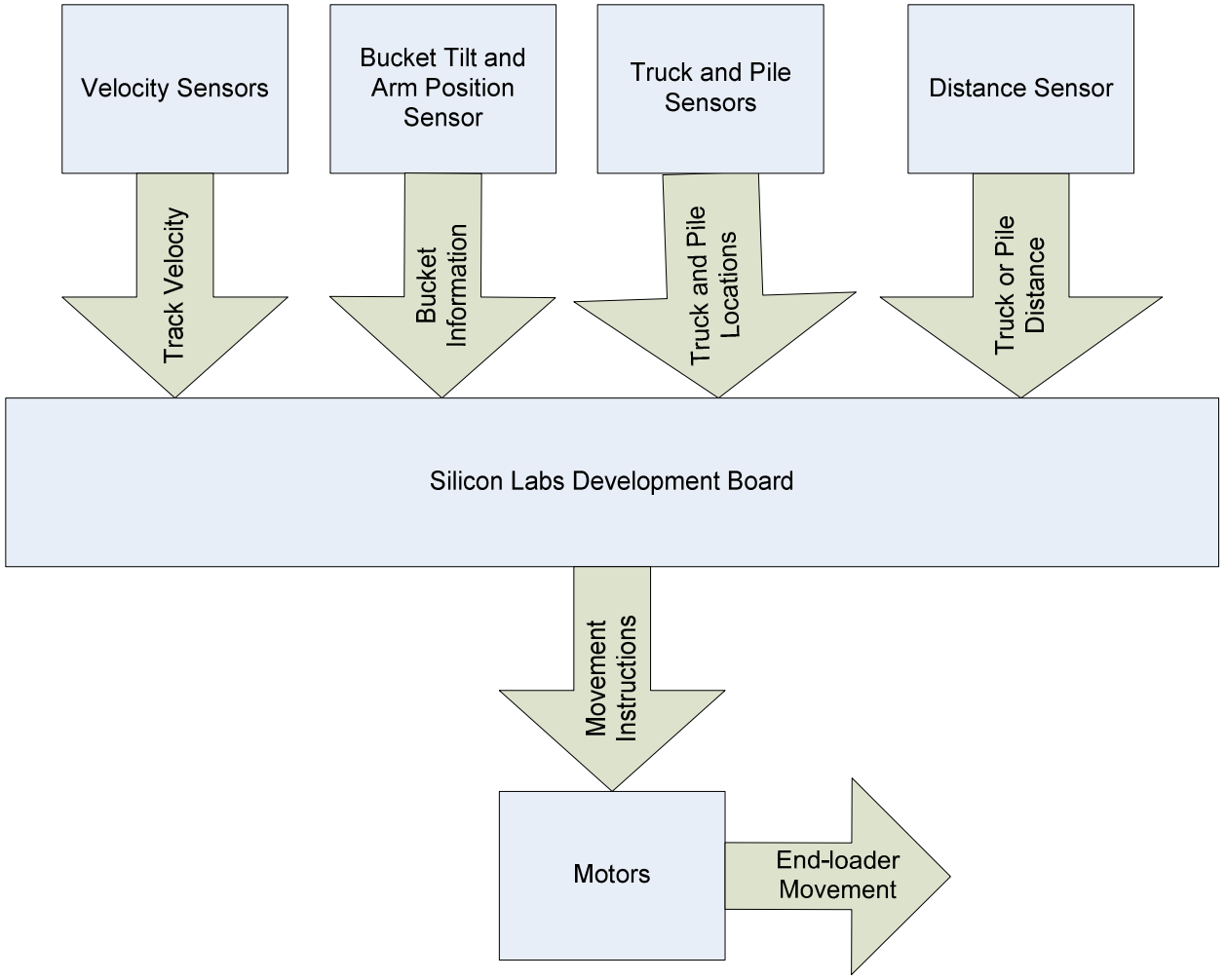
# Overview

- Introduction
- Overall System Block Diagram
- Vehicle
- Truck and Pile Sensors
- Bucket Tilt/Position Sensors
- Distance Sensors
- Velocity Sensor
- Software
- Task Schedule

# Overview

- Introduction
- Overall System Block Diagram
- Vehicle
- Truck and Pile Sensors
- Bucket Tilt/Position Sensors
- Distance Sensors
- Velocity Sensor
- Software
- Task Schedule

# Overall System Block Diagram



# Overview

- Introduction
- Overall System Block Diagram
- Vehicle
- Truck and Pile Sensors
- Bucket Tilt/Position Sensors
- Distance Sensors
- Velocity Sensor
- Software
- Task Schedule

# Vehicle

- Vehicle must be durable to allow for future use and expansion
- Shall be able to run five loading/unloading cycles on a single battery charge
- Motors
  - Shall be able to operate on a PWM signal for varying speed
  - Shall be able to operate in forward or reverse
  - Shall be able to sustain operation with full or empty load

# Vehicle

- Arms/Bucket
  - Shall be able to raise and lower with full load
  - Shall be able to tilt bucket with full load
  - Shall be able to place bucket low enough to scoop a load from the ground

# Vehicle – Tamiya Kit

- Built a version, but it required significant modification
  - Needed additional motors for arm/bucket control
  - Would likely have needed more powerful drive or arm motors
- Could only carry a limited load
- Not very durable

# Vehicle – RC Bobcat


- Much more durable vehicle
- Includes end-point arm sensors and tilt sensors
- Can operate with a significantly larger load

# Overview

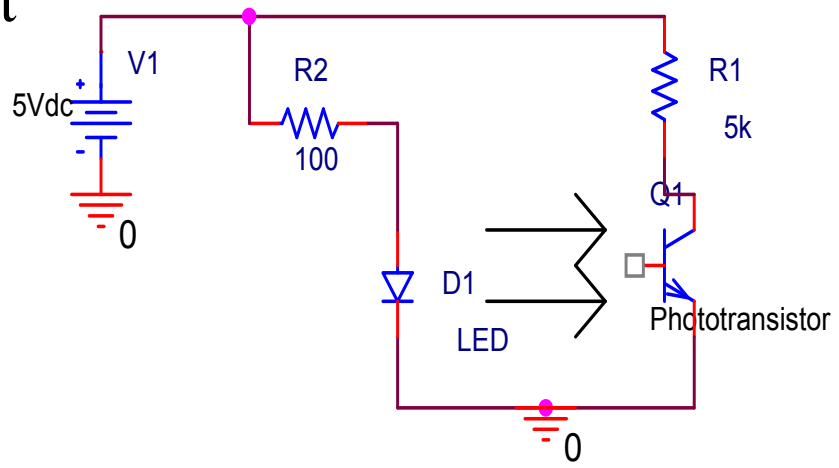
- Introduction
- Overall System Block Diagram
- Vehicle
- Truck and Pile Sensors
- Bucket Tilt/Position Sensors
- Distance Sensors
- Velocity Sensor
- Software
- Task Schedule

# Truck and Pile Sensors

- Determine truck and pile locations
- Shall be able to differentiate between truck and pile
- Shall be able to operate at a range of at least 3 feet

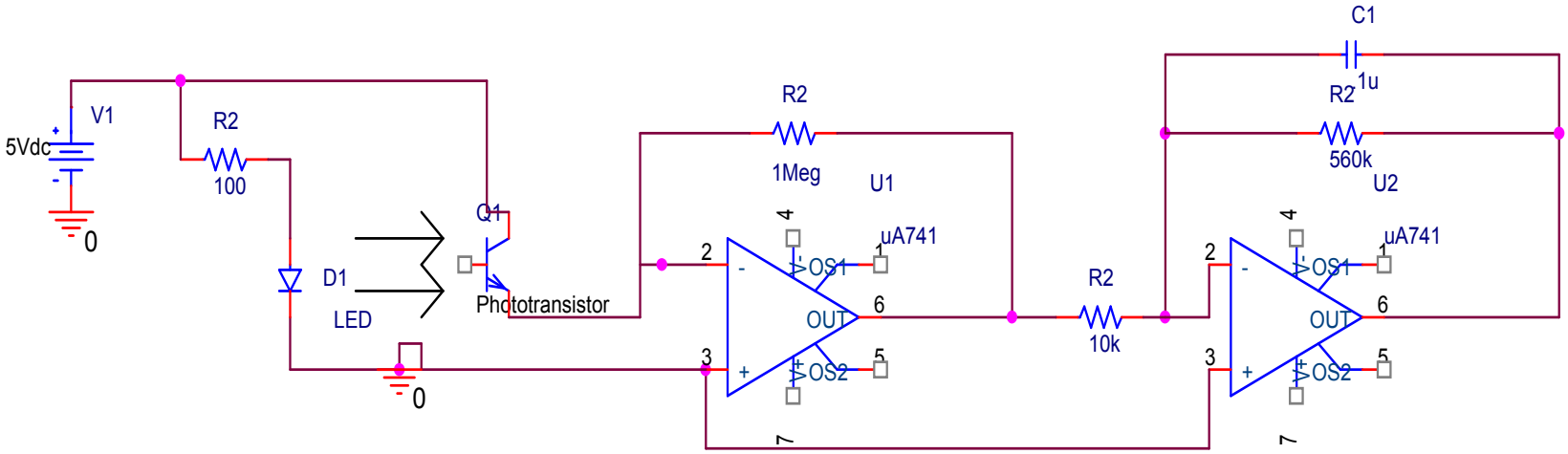
# Truck and Pile Sensors – Infrared Beacons

- Infrared LEDs and Phototransistors
  - Needed shielding on LEDs and phototransistors
    - Limit interference
    - Tells direction more accurately
  - Very limited range – 6 inches
  - Tried adding LEDs, but didn't significantly increase range



# Truck and Pile Sensors – Infrared Beacons

- Current to Voltage Converter
- High gain with LPF to limit noise amplification
- Increased range to 1.5 feet



# Truck and Pile Sensors – Infrared Beacons

- LEDs with higher light output
- Phototransistors with peak wavelength matching LED peak output
- Range to 4 feet
- Can be run with different frequency square wave inputs to differentiate between truck and pile
- Can be improved further

# Truck and Pile Sensors - Compass

- Approximate load and truck location on startup
- Direction to approach truck and load from
- Module with analog representations of X and Y directions
- Still under investigation

# Overview

- Introduction
- Overall System Block Diagram
- Vehicle
- Truck and Pile Sensors
- Bucket Tilt/Position Sensors
- Distance Sensors
- Velocity Sensor
- Software
- Task Schedule

# Overview

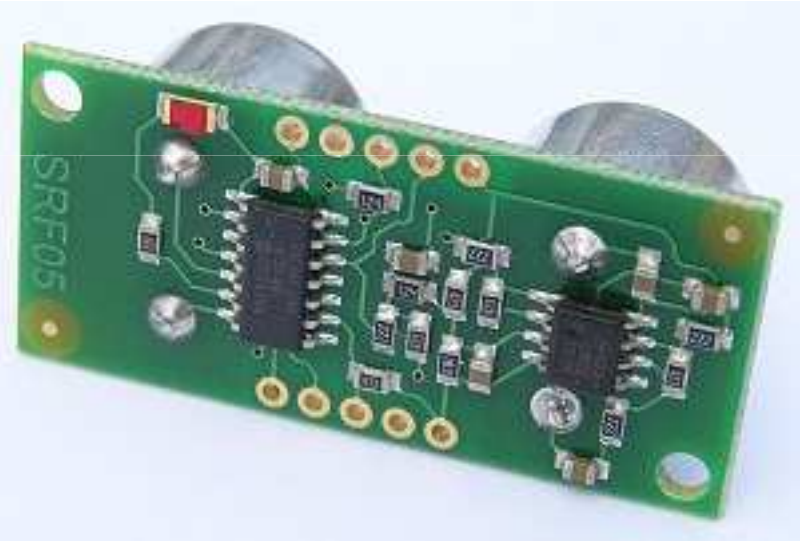
- Introduction
- Overall System Block Diagram
- Vehicle
- Truck and Pile Sensors
- Bucket Tilt/Position Sensors
- Distance Sensors
- Velocity Sensor
- Software
- Task Schedule

# Distance Sensor

- Needed to accurately determine distance from truck or pile when in close proximity
- Infrared beacons are used for object location, they do not tell distance
- Shall be accurate to less than one inch, up to at least 1 foot

# Distance Sensor

- SRF05 Ultrasonic Sensor
- Output is a pulse – the width in uS/148 = inches to object
- Accurate to around 4 feet, down to less than half of an inch



# Overview

- Introduction
- Overall System Block Diagram
- Vehicle
- Truck and Pile Sensors
- Bucket Tilt/Position Sensors
- Distance Sensors
- Velocity Sensor
- Software
- Task Schedule

# Overview

- Introduction
- Overall System Block Diagram
- Vehicle
- Truck and Pile Sensors
- Bucket Tilt/Position Sensors
- Distance Sensors
- Velocity Sensor
- Software
- Task Schedule

# Software

- Shall interpret data from sensors
  - Determine position of truck and load
  - Determine which direction to face at the truck and load
- Provide PWM to appropriate motors
  - Navigate to truck or load
  - Scoop load or dump load into truck
- Stop operation when truck is full

# Overview

- Introduction
- Overall System Block Diagram
- Vehicle
- Truck and Pile Sensors
- Bucket Tilt/Position Sensors
- Distance Sensors
- Velocity Sensor
- Software
- Task Schedule

# Task Schedule

| Lab Period | Overall Tasks/Goals | Kevin | Ryan |
|---|---|---|---|
| 1/29 | sensor mount and test | vehicle modification | vehicle modification |
| 2/5 | sensor mount and test | drive electronics | sensor installation |
| 2/12 | sensor mount and test | drive electronics | sensor installation |
| 2/19 | hardware | circuit board mounting | circuit board mounting |
| 2/26 | hardware | testing | testing |
| 3/4 | software | pwm generation | interpret sensor data |
| 3/11 | software | pwm generation | find truck or pile |
| 3/25 | software | navigate to pile or truck | navigate to pile or truck |
| 4/1 | software | scoop/dump | scoop/dump |
| 4/8 | debug/test | testing | testing |
| 4/15 | debug/test | debugging | debugging |
| 4/22 | debug/test | debugging | debugging |
| 4/29 | final presentation prep | Final Presentation and Report Preparation | |
| 5/6 | final presentation | Final Presentation | |

# Questions