LINE FOLLOWING ROBOT WITH LOAD COLOR RECOGNITION

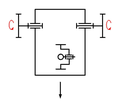
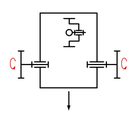
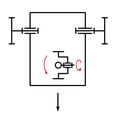
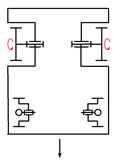
Requirement:
- Line following error = ±3mm
- Minimum speed 0.1 m/s
- Ability to recognize color of load cargo
- Can carry 2 kg of load

Objective:
- Line following error = ±3mm
- Speed = 0.3 m/s
- Recognize 2 color of load cargo
- Carry 2 kg of a load

SELECTION PLANNING

Mechanical

Objective:
- Simple structure
- Easy to drive and steer
- Good traction
- Affordable price

	Three wheel robot (2 driving wheel behind, 1 driven wheel in front)	Three wheel robot (2 driving wheel in front, 1 driven wheel behind)	Three wheel robot (1 steer-driving wheel in front, 2 driven wheel behind)	Four wheel robot (2 driving wheel behind, 2 driven wheel in front)
Kinematic diagram				
Advantages	- 3 wheels are easy to stay coplanar - Better traction - Simple mechanism	- 3 wheels are easy to stay coplanar - Better traction - Simple mechanism	- 3 wheels are easy to stay coplanar - Better traction	- Evenly distributed weight
Drawbacks	- Chance of rolling over when steering highspeed - Weight is not evenly distributed	- Chance of understeer in curve road with high speed - Weight is not evenly distributed	- Single steer drive wheel requires high torque motor - Steer drive wheel is expensive	- Hard to stay coplanar

Choose three wheel robot with 2 driving wheel behind, 1 driven wheel in front

Electrical

Objective:
- Recognize load
- Recognize load color
- Recognize black line on white background with low error.
- Suitable size and capacity of power source

Load, color sensor

Requirement: can detect when load is on and its color

Infrared, RGB sensor:
- An integration of proximity sensor to detect object distance and RGB sensor to detect color

RGB sensor:
- Simple sensor to detect color only

Choose RGB sensor for programming simplicity, combine both loading and color recognition in the same stage

Line detector

Requirement: can detect the contrast between white and black line

Camera:
- Slow response
- High accuracy
- Detect all planar coordinates on single module
- Simple arrangement
- Very expensive price
- Suitable for all type of line

IR phototransistor sensor:
- Fast response
- High accuracy
- Need complex arrangement of modules to detect all planar coordinates
- Low price
- Suitable for high contrast line

Choose IR phototransistor sensor because it is sufficiently suitable for black and white roadmap and much cheaper than camera

Power source

Requirement: easy to fit in robot and high capacity to run for desired time

Lithium Ion battery:
- Heavier weight, can install on the robot with apporiate housing.
- Capable of recharge for further usage
- Higher capacity than LiPo battery
- Affordable price

Lithium Polymer battery:
- Light weight, can be easily installed on the robot.
- Capable of recharging for further usage.
- Lower capacity
- Expensive

Choose Lithium Ion battery as power source

Controllers

Objective:
- Implementable control algorithm on microcontroller
- Easy for parallel workflow
- Precise and fast signal transmission

Sensor signal processing

Weighted Approximation:
- Small error
- Easy to implement
- Depend on preset weight

Quadratic approximation:
- Small error
- More complex computation
- Depend on selected number of highest reading of sensor

Choose weighted approximation algorithm for error calculation

Structure

Single concentric:
- Fast response
- Simplify the board design process
- Hard to test many devices at the same time
- Have to be precise with interrupt timing to receive of many connected devices

Hierarchial:
- Slower response because of communication between devices
- Make board design process more complex
- Suitable for testing many devices at once

Choose hierarchial control structure for parallel workflow and testing

Choose microcontroller and communication type

COMMUNICATION TYPE SELECTION

Type	I2C	SPI	UART
Available Connection	Multiple master - multiple slave	1 master - multiple slave	1 master - 1 slave
Speed	10 - 100Kbps	10Mbps	1Mbps

Choose I2C for communication between microcontroller board, UART for communication with computer for testing

MICROCONTROLLER SELECTION

Function	Master	Sensor	Motor
Features	- Have enough ports for communication with slaves - Small size - Easy to program and communicate	- Have sufficient analog ports to receive sensors data - Small size - Easy to program and communicate	- Small size - Easy to program and communicate

Choose ATMega32 for master, sensors signal are handled by master because it has 8 analog ports
Choose ATMega328P as motor slaves for simple programming with master

LINE FOLLOWING AUTOMATIC GUIDED VEHICLE					MECHATRONICS PROJECT	
Func.	Full name	Sign	Date		Quantity	Weight	Scale
Designer	Tr.A.Quoc		20/12	Selection methods			
	H.B.Loc				Sheet: 4	Total sheets: 4	
	P.D.K.Nguyen				HCMC University of Technology Faculty of Mechanical Engineering		
	Ng.H.Minh						
Instruct.	V.T.Quan						
Approve	V.T.Quan						