EEE116
Experimental, Computer Skills and Sustainability

Week 3 Smart car pre-lab tutorial

Xi'an Jiaotong-Liverpool University

西交利物浦大学

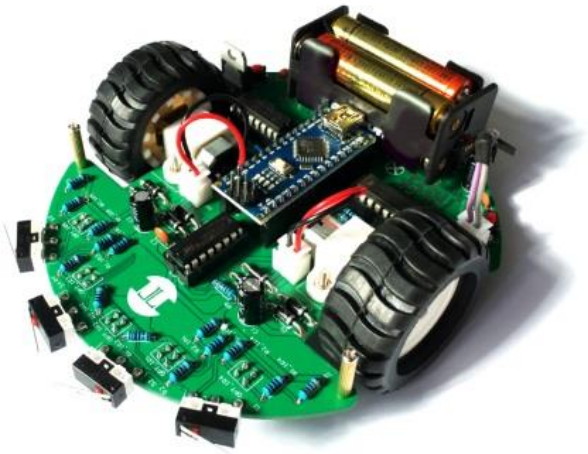
Smart Car

Xi'an Jiaotong-Liverpool University
西交利物浦大學

Objective:

- To learn and practice the soldering skills
- To build the electronic smart car from a given circuit diagram
- Troubleshooting and problem solving
- Teamwork and technical report writing skills

The ‘Smart’ car



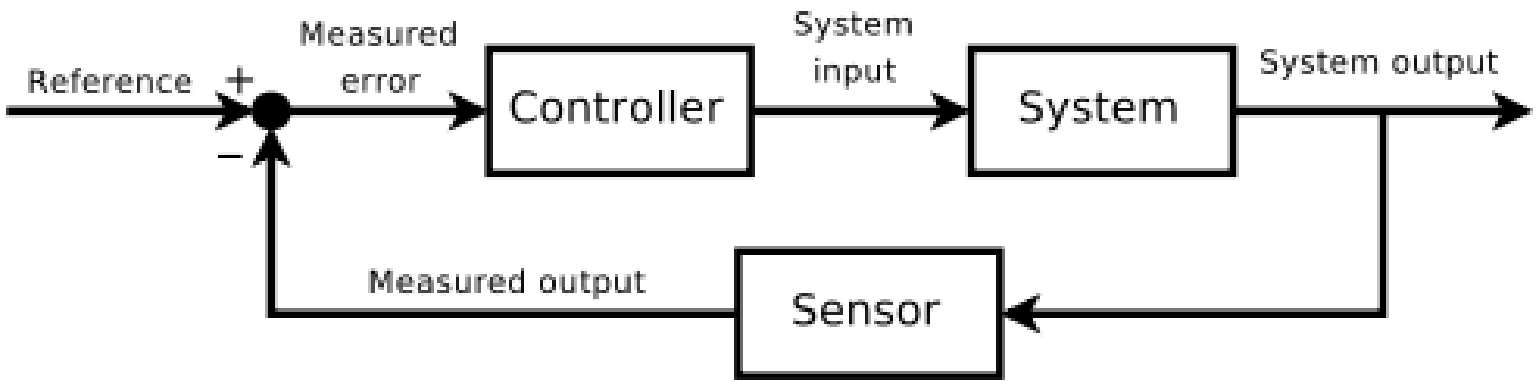
VS

Tesla Autopilot

Google Self-Driving Car

http://v.youku.com/v_show/id_XMTcxNTYxMTc2OA==.html?spm=a2hzp.8244740.userfeed.5!10~5~5~5!3~5~A

Feedback control



Open loop control: Fan, washing machine…
(also called non-feedback control)

Close loop control: Air conditioner, Cruise Control

Smart Car Project (30%)

Xi'an Jiaotong-Liverpool University 西交利物浦大學

Part I (5%): Individual work

Soldering skills – simple electronic circuit (LED running lights)

Part II (15%): Group work

Smart car– build and test on more comprehensive electronic circuit (Tea#1 smart car)

Part III (10%): Individual work

Lab skills– Oscilloscope, function generator, power supply, multi-meter

Smart car project planning

Xi'an Jiaotong-Liverpool University 西交利物浦大學

Week	Lab name	Student group	Assessment
Week-1			
Week-2	Soldering running LED light	**Group A&B**	Soldering skills
Week-3	Smart car 1	**Group A**	Lab skills
Week-4	Smart car 1	**Group B**	Lab skills
Week-5	Smart car 2	**Group A**	Bench inspection for smart car (**Group A**)
	Matlab computer lab 1	**Group B**	
Week-6	Smart car 2	**Group B**	Bench inspection for smart car (**Group B**)
	Matlab computer lab 1	**Group A**	
Week-7	Mid term		

***Please check out detailed grouping results on ICE.**

Assessment for Smart car (15%)

Xi'an Jiaotong-Liverpool University 西交利物浦大學

Bench inspection		Report	Final Racing	
Functionality	Soldering	Combined with Digital clock report (10% in total)		Total
5%	5%		5%	15%

- Bench inspection due day for basic test:
  Week 5 (group A) & Week 6 (group B)
- Functionality: Pass the 5 tests in Chapter 5 (Tea 1 Testing) of the Manual.
- Don't wait until the last week to start writing the report.

Lab Rules !

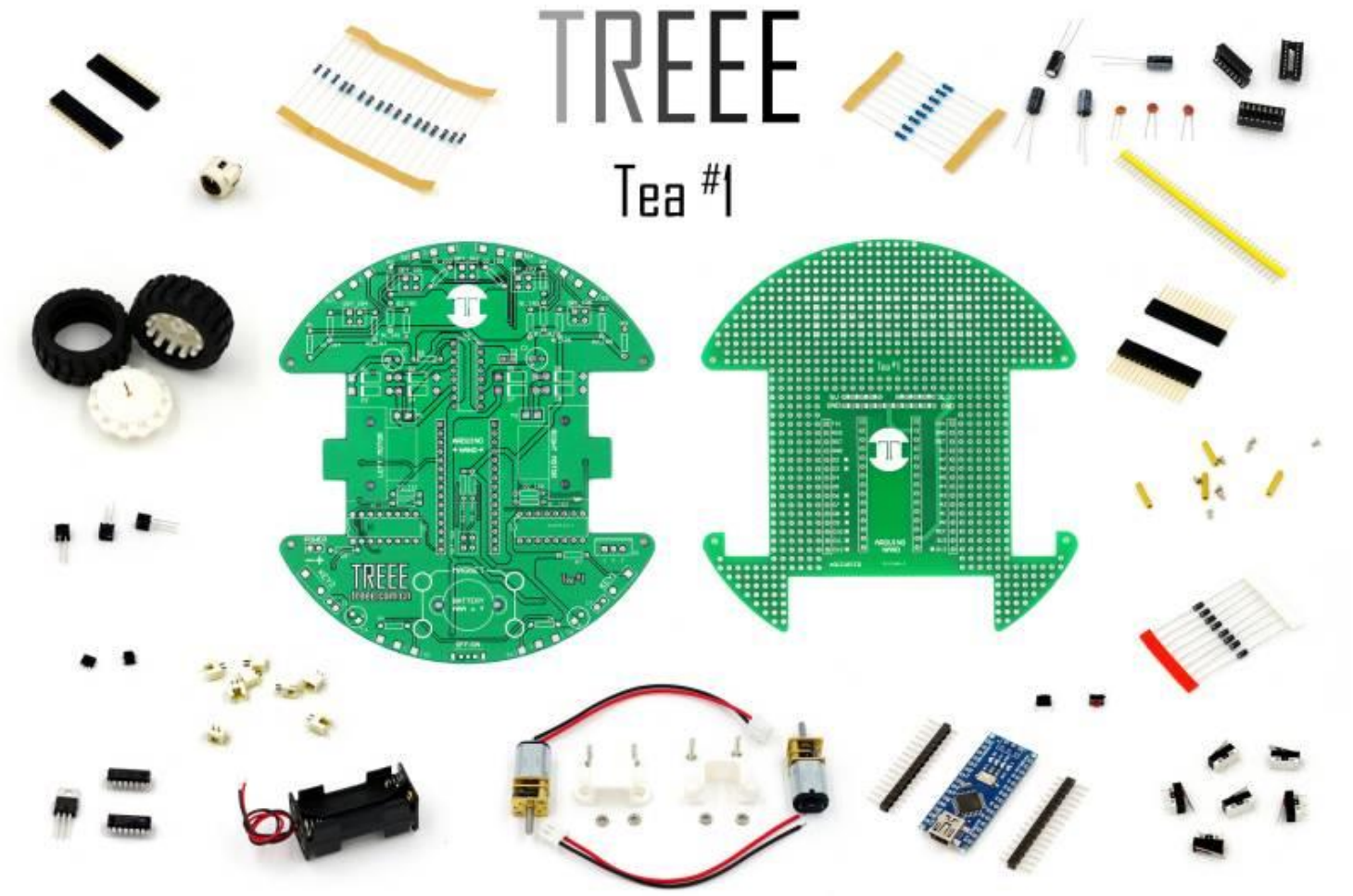
Please strictly obey the lab rules!

Please review Health and Safety Handbook of EEE and check the lab rules posted on the wall of each lab!

Electronic assembly

Xi'an Jiaotong-Liverpool University
西交利物浦大學

Check component list: don't start soldering if miss any

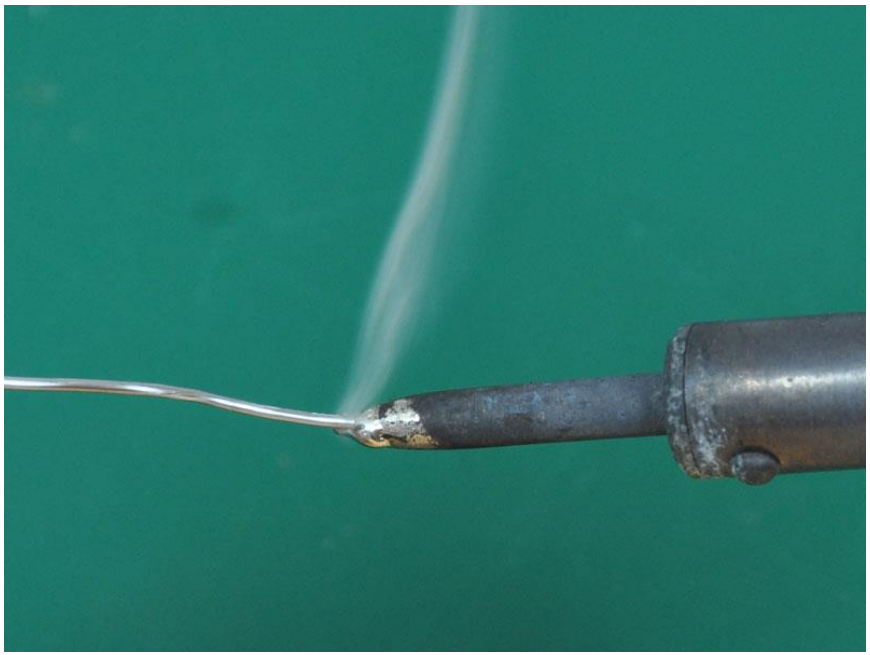


Soldering skills

1. Prepare the soldering iron.

2. Prepare the surface.

3. Start to solder.



SMD soldering

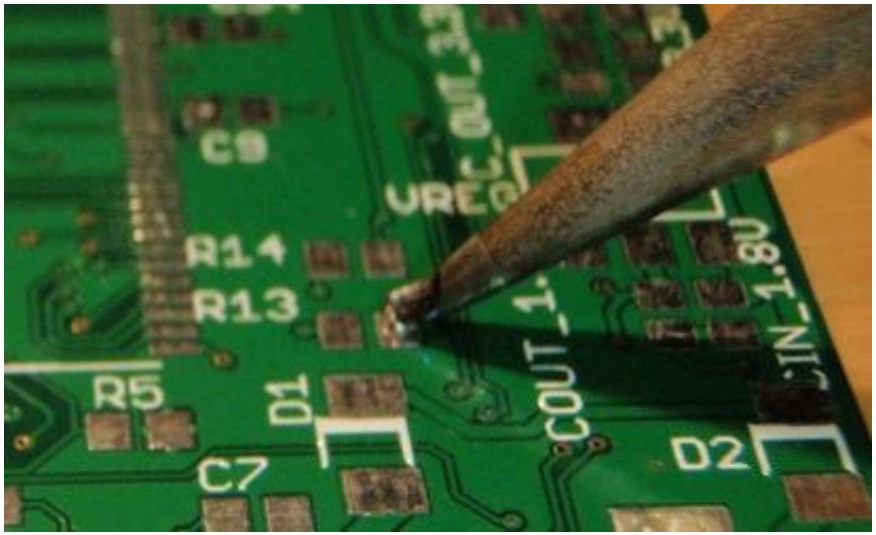
Xi'an Jiaotong-Liverpool University 西交利物浦大學

SMD stands for Surface Mount Device

Apply some solder to the tip of your iron and touch the circuit board pad with the tip so that some of the solder passes on to the pad.

Place the resistor in its place an hold it there with a pair of tweezers while you touch the soldering tip so that it heats both the component and circuit board pad.

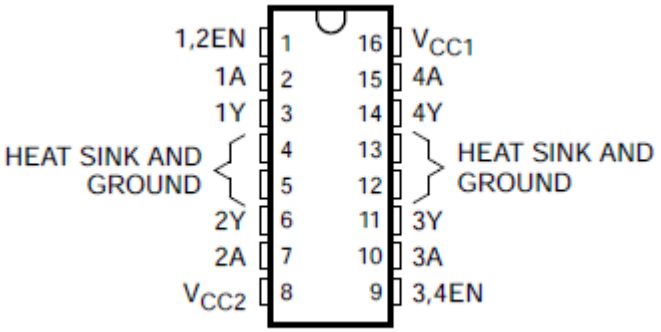
The resistor should now be fastened on one side. Apply solder to the soldering tip again and touch the iron tip on the other side.



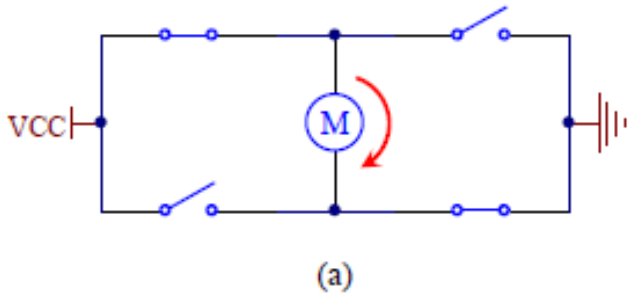
Build your smart car

http://v.youku.com/v_show/id_XMTc0MjAzNjY4NA==.html?spm=a2hzp.8244740.userfeed.5!8~5~5~5!3~5~A

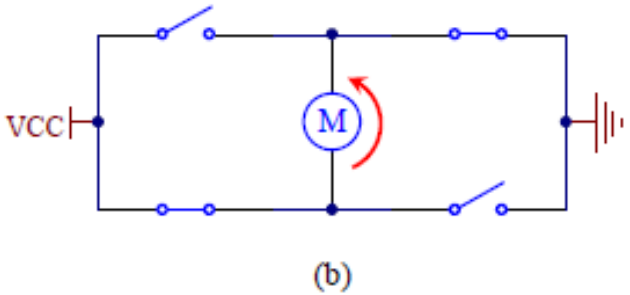
Motor and driver



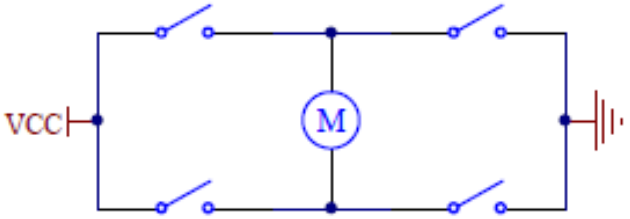
L293



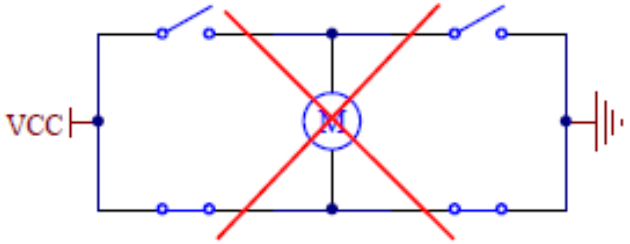
(a)



(b)



(c)

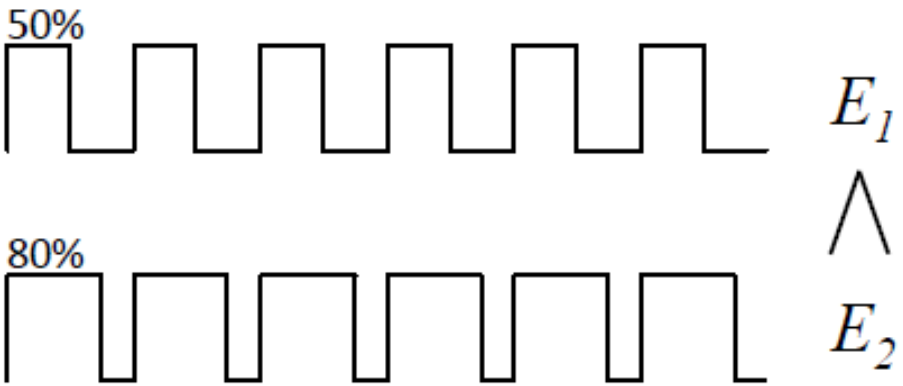


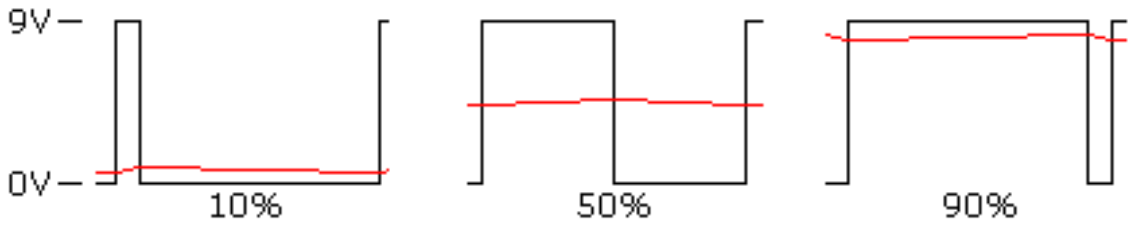
(d)

PWM (to control the speed)

Xi'an Jiaotong-Liverpool University 西交利物浦大學

Pulse Width Modulation (PWM) uses digital signals to control power applications





Examples of PWM Waveforms

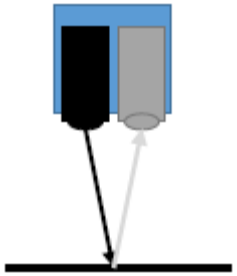
Sensors and switch

Xi'an Jiaotong-Liverpool University
西交利物浦大學

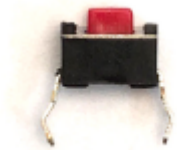
IR sensor

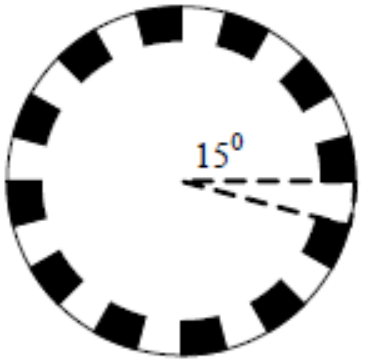
Impact switch

IR speed sensor

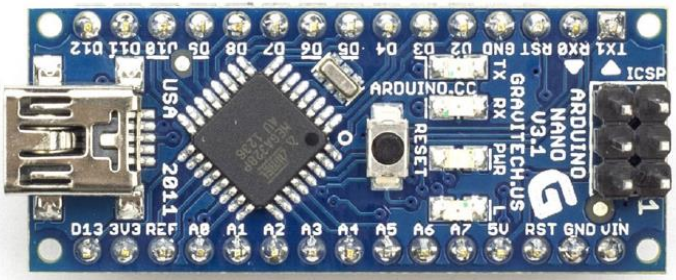


micro switch





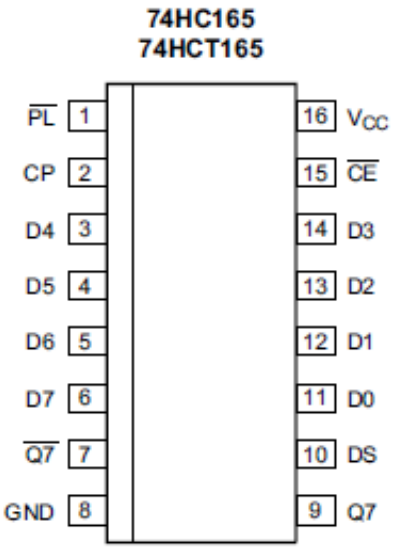
Micro-controller



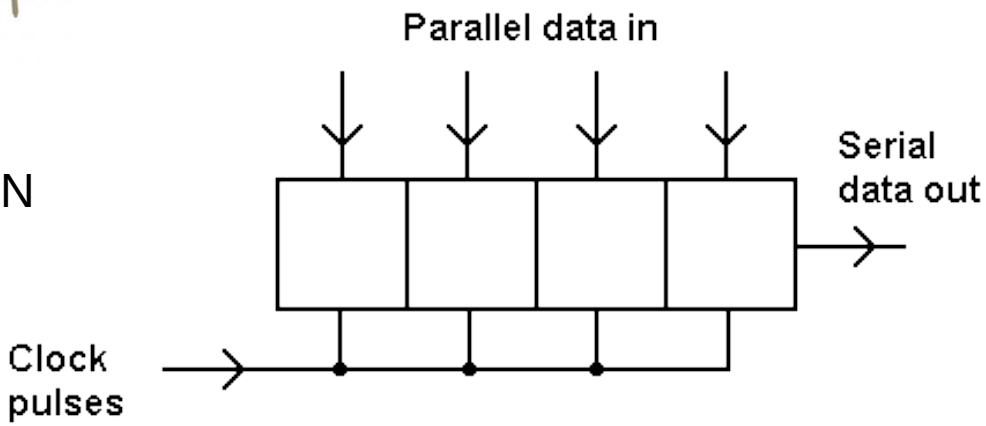
Arduino Nano Development Board

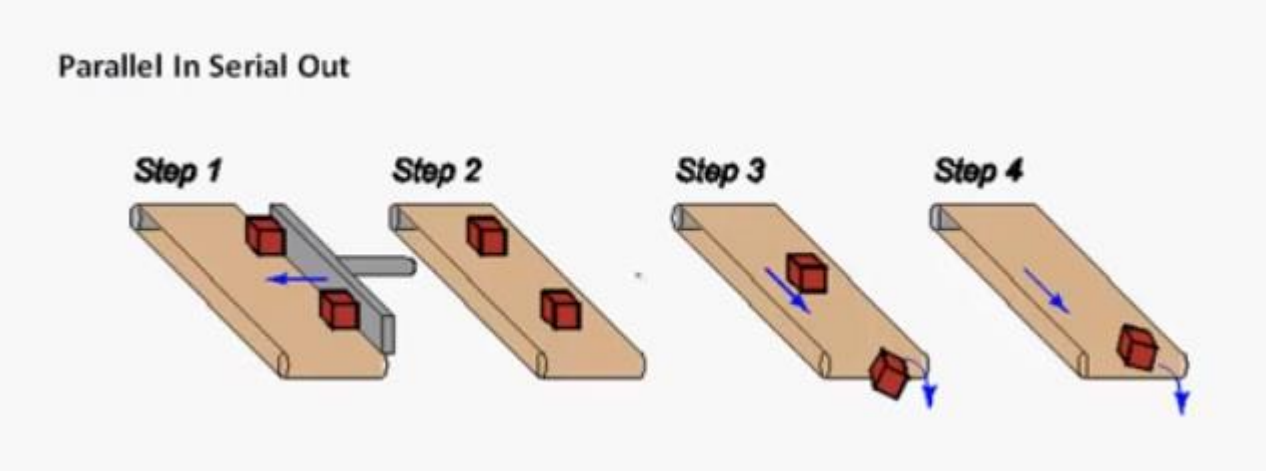
Arduino is an open-source prototyping platform based on easy-to-use hardware and software.

Shift register

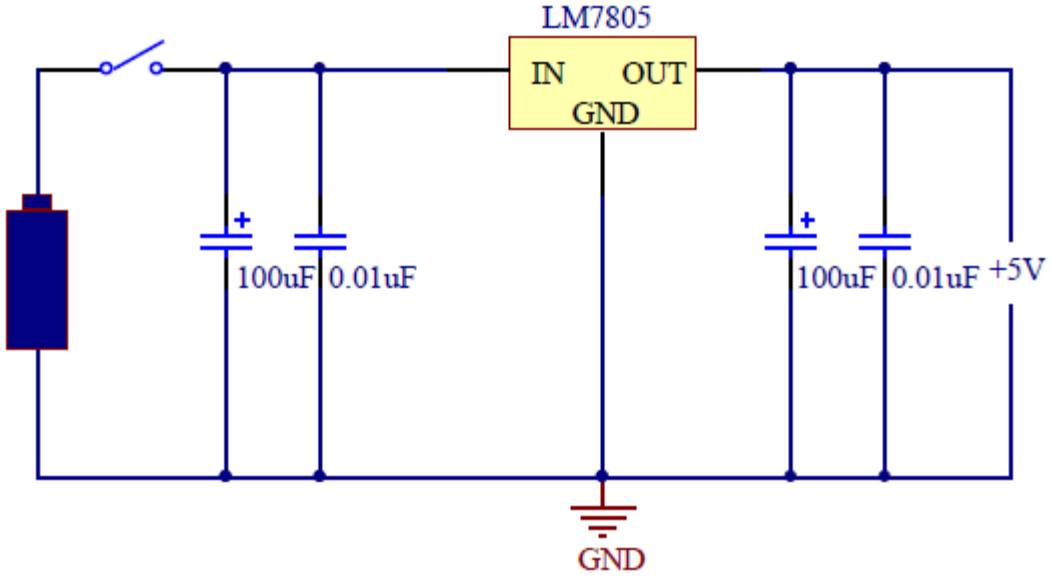


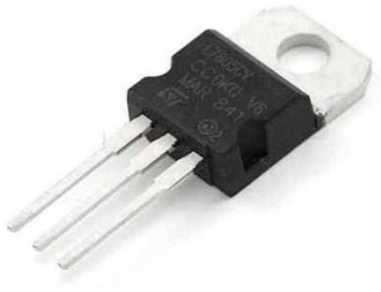
74HC165N





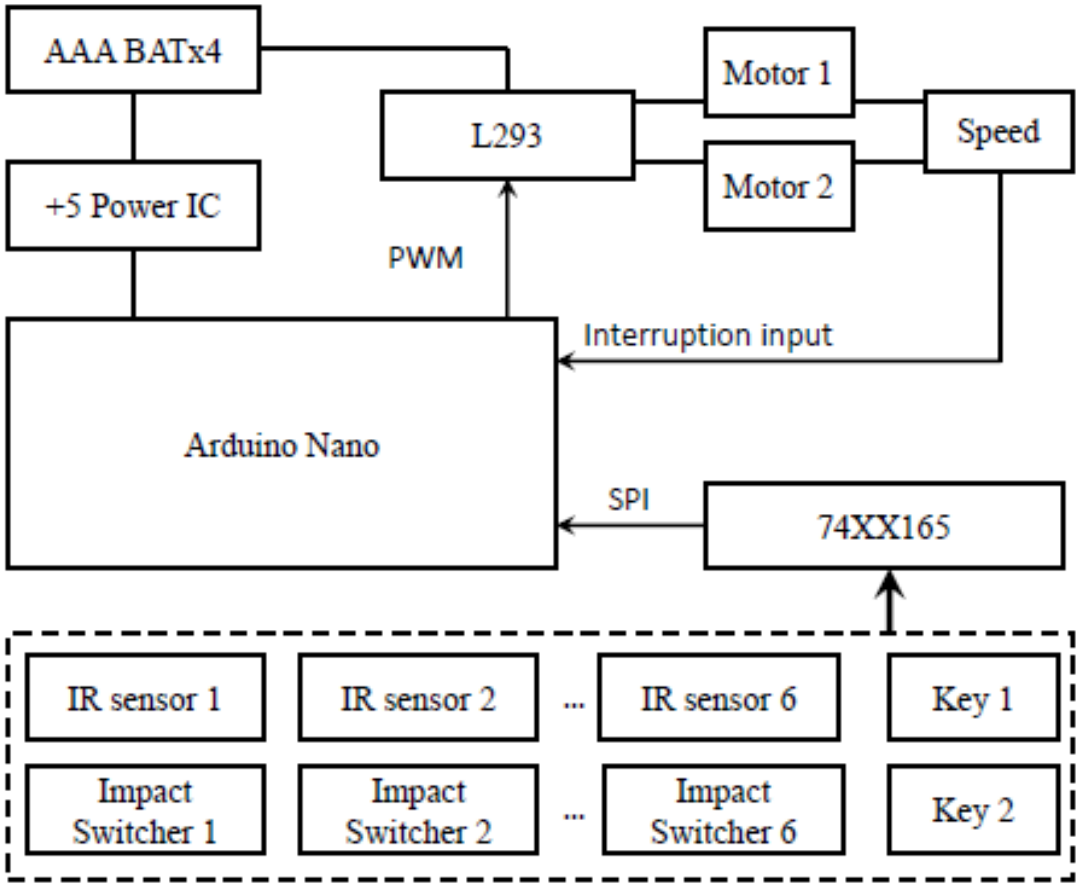
Power supply





LM7805

Block diagram



Arduino Software (IDE)

Xi'an Jiaotong-Liverpool University
西交利物浦大學

Language reference

Xi'an Jiaotong-Liverpool University 西交利物浦大學

Structure

- setup()
- loop()

Control Structures

- if
- if...else
- for
- switch case
- while
- do... while
- break
- continue
- return
- goto

Variables

Constants

- HIGH | LOW
- INPUT | OUTPUT | INPUT_PULLUP
- LED_BUILTIN
- true | false
- integer constants
- floating point constants

Data Types

- void
- boolean
- char
- unsigned char
- byte

Functions

Digital I/O

- pinMode()
- digitalWrite()
- digitalRead()

Analog I/O

- analogReference()
- analogRead()
- analogWrite() - *PWM*

Due & Zero only

- analogReadResolution()
- analogWriteResolution()

Advanced I/O

https://www.arduino.cc/en/Reference/HomePage

Built-In Examples

1. Basics

- Analog Read Serial: Read a potentiometer, print its state out to the Arduino Serial Monitor.
- Bare Minimum: The bare minimum of code needed to start an Arduino sketch.
- Blink: Turn an LED on and off.
- Digital Read Serial: Read a switch, print the state out to the Arduino Serial Monitor.
- Fade: Demonstrates the use of analog output to fade an LED.
- Read Analog Voltage: Reads an analog input and prints the voltage to the Serial Monitor.

2. Digital

- Blink Without Delay: Blink an LED without using the delay() function.
- Button: Use a pushbutton to control an LED.
- Debounce: Read a pushbutton, filtering noise.
- Digital Input Pullup: Demonstrates the use of INPUT_PULLUP with pinMode().
- State Change Detection: Count the number of button pushes.
- Tone Keyboard: A three-key musical keyboard using force sensors and a piezo speaker.
- Tone Melody: Play a melody with a Piezo speaker.
- Tone Multiple: Play tones on multiple speakers sequentially using the tone() command.
- Tone Pitch Follower: Play a pitch on a piezo speaker depending on an analog input.

https://www.arduino.cc/en/Tutorial/BuiltInExamples

Basic function test

- Keys and impact switchers
- IR sensors
- Motors
- IR speed sensors
- Test all function

http://v.youku.com/v_show/id_XMTc5MTQzMDA0OA==.html?spm=a2hzp.8244740.0.0

Applications

Black Line Tracking

Use the IR sensor placed under the car to detect the black line. Turn the car towards the black line.

Collision Avoidance and failing prevention

Use the impact switchers to detect the barrier and IR sensor for the edge of the surface. Move backward a little if the impact switchers been triggered.

Report

Why a report

The objective of writing a report is to convey information to the reader. When writing your report, you should aim it at people that have not done this experiment and are really interested to see what results you have obtained. Imagine you write the report to help Year 1 students learn more about Year 2 experiments. Therefore, your report should be clear, straightforward and you should not omit important data/information.

A good test is to pass your report to someone else to read and see if they can follow it. If a non-technical person finds your report readable and interesting, your job is well done!

Suggested structure

Xi'an Jiaotong-Liverpool University 西交利物浦大學

1. Title page (title of the experiment & authors' name)
2. Abstract
3. Introduction
4. Theory,Experimental,Results,Discussion
   - Theory,Circuit design
   - Experimental method
   - Results and Calculations
   - Discussion
5. Conclusion
6. References

JUST A EXAMPLE

Abstract

a short section of between 50 and 300 words which must be capable of being read and understood independently of the rest of the report. This section should briefly summarise

(a) the purpose and scope of the experiment,

(b) the experimental procedures that were carried out,

(c) the main conclusions. This section is possibly the most difficult to write and you are advised to write it last.

Introduction

This section describes, in general terms, the scope of the experiment and its relevance to the field of study you are engaged in. A statement of objectives should be given along with general comments about how the experiment will be carried out. That is,

1) use the first paragraph to explain in a short paragraph the purpose of your experiment. What did you want to measure and why does someone (electrical engineer or not) need to know about the results in this report. You want to make your report appealing, important.

2) use the space of another short paragraph to trigger the reader's interest about your work. You should reveal the most important findings but not everything. You want the reader to continue and read all your report, not just the introduction

Main Body I

1. Theory - describing the theoretical background to the experiment and maybe anticipating some of the expected results.
2. Circuit design - details should be given of any circuit design that was carried out.
3. Experimental method - giving details of what equipment was required and how it was used. Details should be given of how measurements were made.

Main Body II

4. Results and Calculations - Present experimental readings in tabular form with estimates of reading errors. If the experiment had included a design exercise, e.g. of a logic circuit, your results should indicate how it was tested whether or not the circuit was ultimately found to be successful. Calculations based on experimental readings should be presented in a form, which allows them to be checked. Graphs are normally more informative than tabular results and should be presented whenever appropriate, even when not specifically requested.
5. Discussion - always included to give an assessment of the significance and reliability of the results, to consider the implications of experimental errors and to propose possible alternative approaches and further experiments that could be carried out.

Conclusion

It is a concise statement of what has been learnt from or confirmed by the experiment. This section must be consistent with earlier sections.

Usually, a short paragraph is used here to summarise the most important findings. It often contains similar information to the second paragraph of the introduction but there is reference to practical applications in which the described work might be used.

References

You may refer to textbooks, research papers, magazine articles, data sheets and lecture notes as references.

You need to provide references for anything which is not your work.

References should be listed in a separate section at the end of the report, in the following form:

REFERENCES

[1] Gibson J.R. "Electronic Logic Circuits", Edward Arnold (Publishers) Ltd., 1979, p. 90.

[2] Cheetham B.M.G. and Hughes P.M., "Digital Filter Design" (Part II), Wireless World, June 1982, pp 43 - 46.

[3] Experiment No. 33, "Two state (logic) transistor circuits", University of Liverpool, Laboratory Script.

Tips for Working in Groups

Xi'an Jiaotong-Liverpool University 西交利物浦大學

Working together in a group can be a great experience or a terrible one. Which way it goes depends, to a large extent, on the quality of the communication among group members and the respect they show for each other. Here are a few guidelines for making your group work successful.

1. Work hard. For all activities, do your share and a little bit more. Be responsible, and then add a little extra to bring the standards of the group up and make its success more likely.
2. Be inclusive. Bring every member of the group in on discussions, decision making, and activities. Give everyone a chance to speak, listen to them, and give serious consideration to what they are saying. Cooperate.
3. Take turns. Don't be the leader all the time. Don't be a follower all the time. Don't talk too much--listen to others. Don't just listen to others—share your opinions too.
4. Be nice. Avoid personal criticism. Make sure you understand what someone is saying before you weigh in with your opinion about it. Give them the benefit of the doubt.

Tips for Working in Groups (Cont.)

5. Be timely. Show up promptly for meetings. Meet all deadlines. When you're late, you waste people's time and make them mad. People depend on you. Get it done on time.
6. Don't be an enabler. If you've got somebody who isn't doing their work, hold them responsible as a group. Everyone needs to do their part.
7. Stay focused on the task. Make your meetings count. Don't drift into irrelevant subjects. Be mindful about what you need to accomplish.
8. Improve the mood of the group. Be positive. Be fun. Be appreciative of other people. Be full of good ideas. Do your part to make the environment a good one.
9. Don't cast blame unfairly. If there is a problem in the group, begin by asking what you have done (or not done) to contribute to that problem—and what you might do to fix it. If there is conflict, try to work it out through respectful talk with each other (not e-mail, a horrible conflict medium). Try to understand the other person's point of view as you discuss the issue.

http://www.speaking.pitt.edu/student/groups/smallgrouptips.html

Some other things…

Xi'an Jiaotong-Liverpool University 西交利物浦大學

Pay attention to the polarity, notches on the component.

Bring a computer to the lab.

The team coordinators have the responsibility to contact your team member.

Try to share the work load evenly.

If all your team members are not showing up or responding your emails, please contact me for re-grouping.

THANKS

Xi'an Jiaotong-Liverpool University

西交利物浦大学

Boston Dynamics