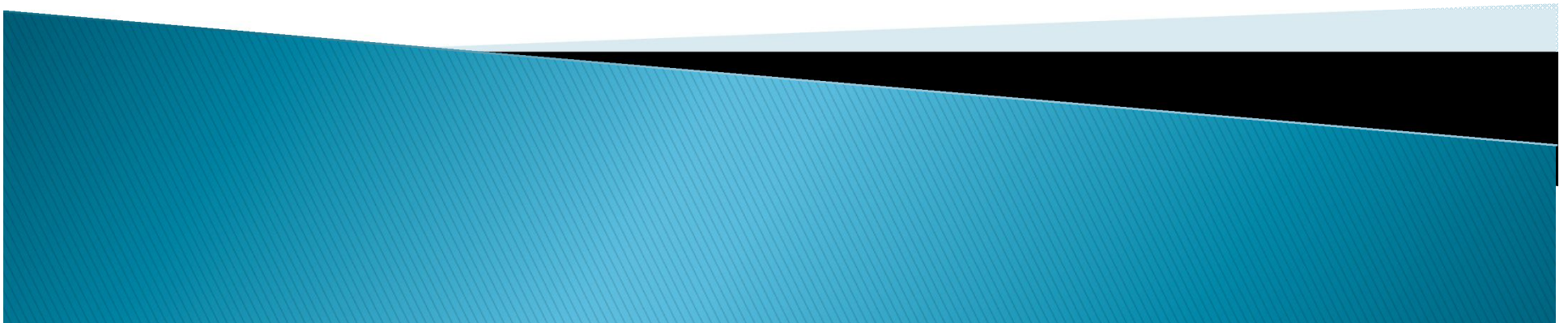


HARDWARE DESIGN



Overview

- Key Issues

- Problems and general scenario

- Hardware Design

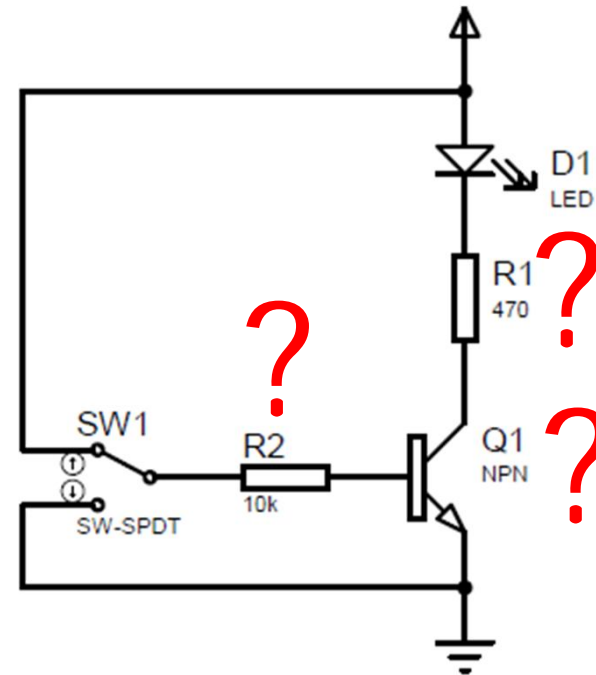
- Associated problems
- General design requirements
- General design steps
- Experiences
- Recommendations



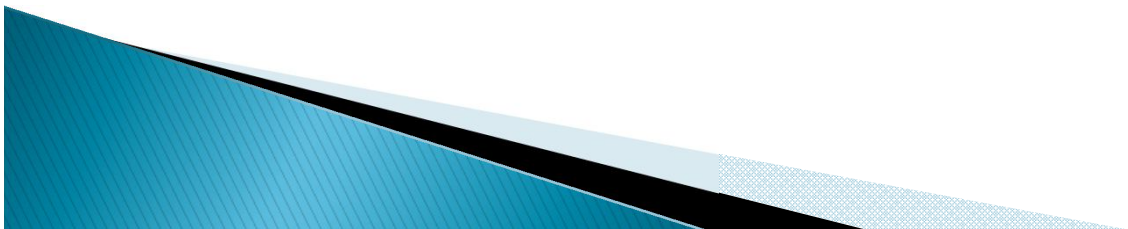
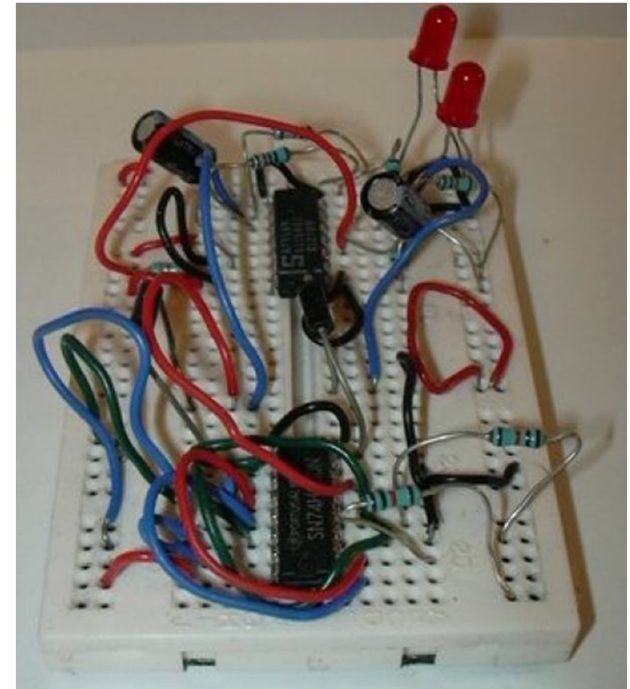
Key Issues

- ▶ Academics are dominantly theory based and exams oriented.

• Most of the students of electronics and communication engineering do not know how to design a simple transistor switch for lighting a LED bulb.



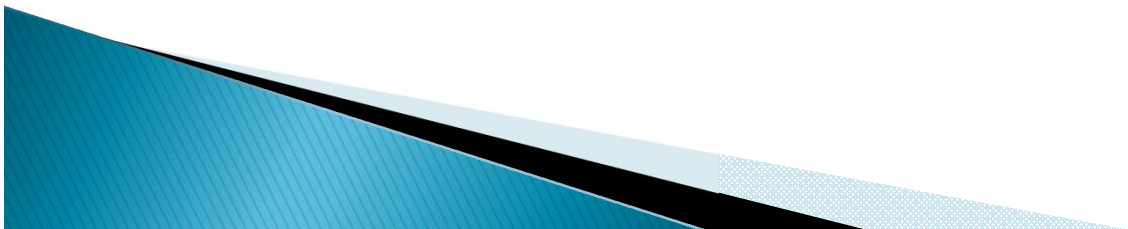
- ▶ Real world problems
 - Operation of circuits drastically changes at different instants and places.
 - Problems get solved without any action taken.
 - Some problems get no logical explanations and appear divine.



- ▶ Lack of availability of resources
 - Lack of availability of sufficient resources in local market
 - Lack of knowledge of whereabouts of the local market places for electronic components and devices
 - Expensive



- ▶ Hardware Design: Multidisciplinary and vague topic
- ▶ Contents of this presentation are narrowed to **Hardware Design for Robotics applications for beginners in the context of Nepal**
- ▶ Experiences sharing



Hardware Design



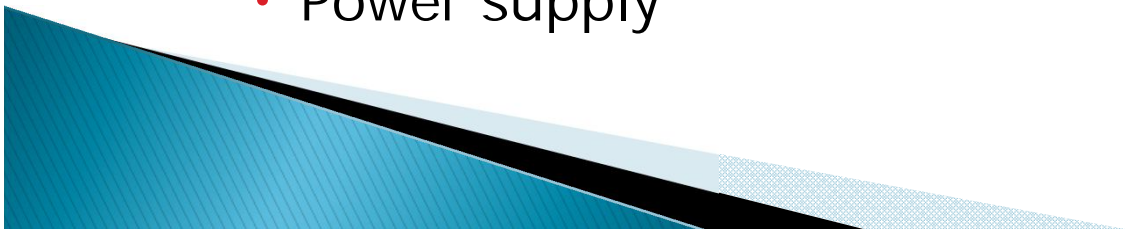
Steps involved in Hardware Design

1. Set your objectives
2. Design a test circuit considering
 - Availability of components in the market
 - Expenses
 - Complexity
 - Reliability
 - Need for Replication
3. Testing and debugging
4. Final circuit design
5. Finishing

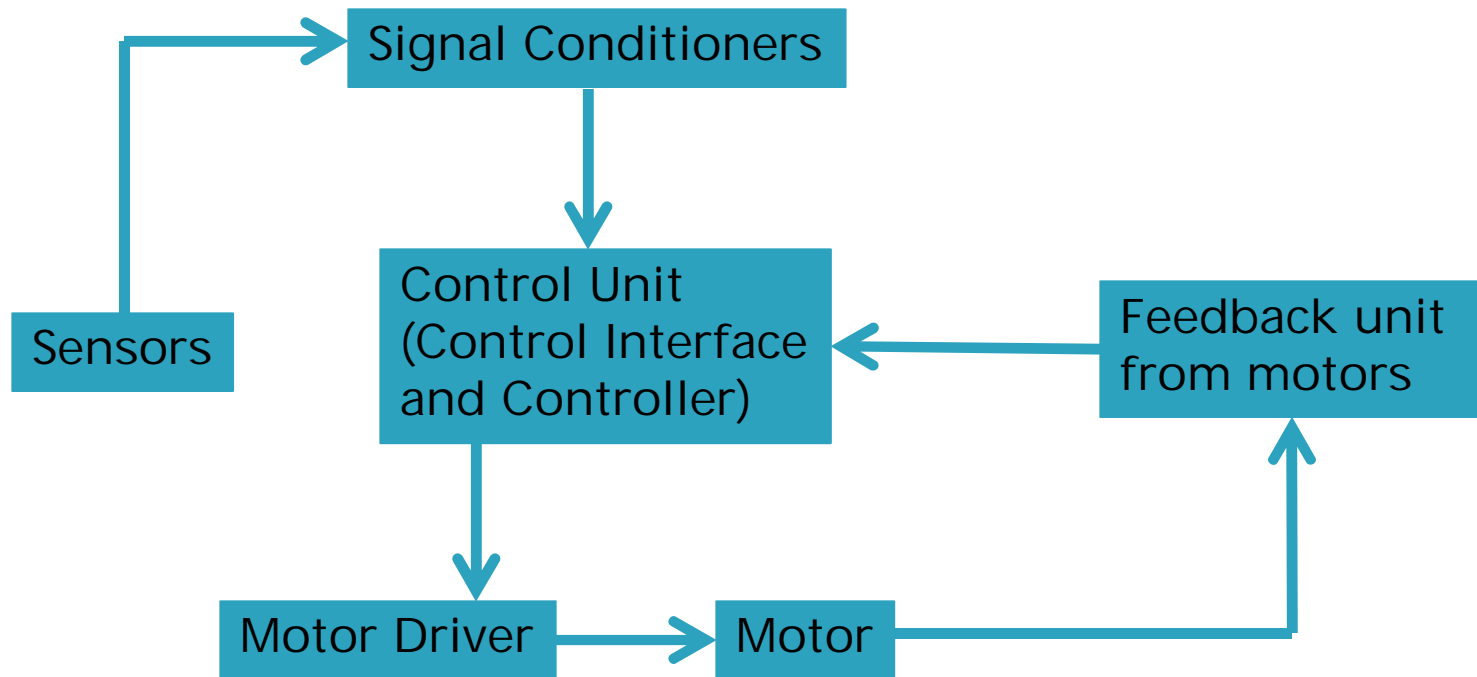


How to start?

- ▶ Familiarization with datasheets
 - Maximum ratings
 - DC and AC characteristics
- ▶ Familiarization with basic electronic components, their circuits and their applications
- ▶ Breadboarding, soldering and tools handling
- ▶ Instruments handling
 - Multimeter
 - Oscilloscope
 - Function generator
 - Power supply



Hardware Design for Robotics



General Block diagram of Robot Control System



Sensors

- ▶ Optical Sensors
 - Reflection
 - Proximity
 - Color detection
 - Transmission
 - Obstruction detection
 - Rotatory optical encoders
- ▶ Light emitting devices
 - LED
 - IR LED
 - LASER



- ▶ Light detection devices
 - LDR (slow response)
 - Photodiode
 - TSOP (for IR LED remote controls)
 - Phototransistors



- ▶ Problems associated
 - Line of sight requirement
 - Ambient light problems
 - Operating range



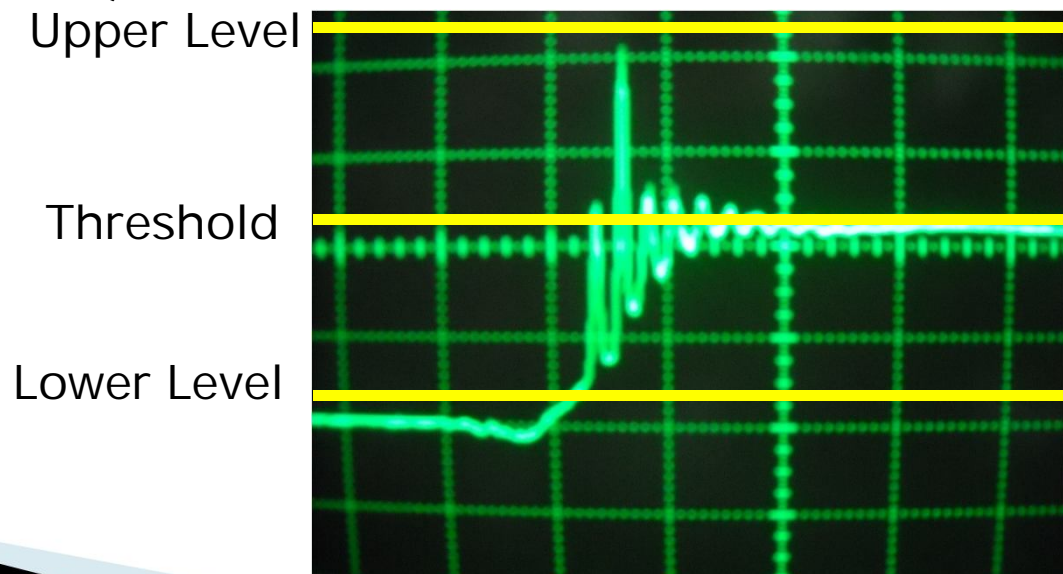
- ▶ Ultrasonic sensors
- ▶ Current sensing
 - Current sense resistors
 - Hall effect sensors
- ▶ Potentiometers
 - Voltage detection
 - Tachometer
- ▶ Limit switches

Use standard sensors



Signal Conditioners

- ▶ Buffers
- ▶ Amplifiers
- ▶ Comparators
- ▶ Schmitt triggers (avoids bouncing at thresholds)



- ▶ ADC
- ▶ Filters
 - Use active filters to avoid loading effect
- ▶ Choice of components
 - Op-amps (LM324, LM358, 741)
 - Consider opamp saturation and frequency response
 - Single supply considerations
 - Precision components may be required
 - 1% tolerance resistors
 - Polyester capacitors



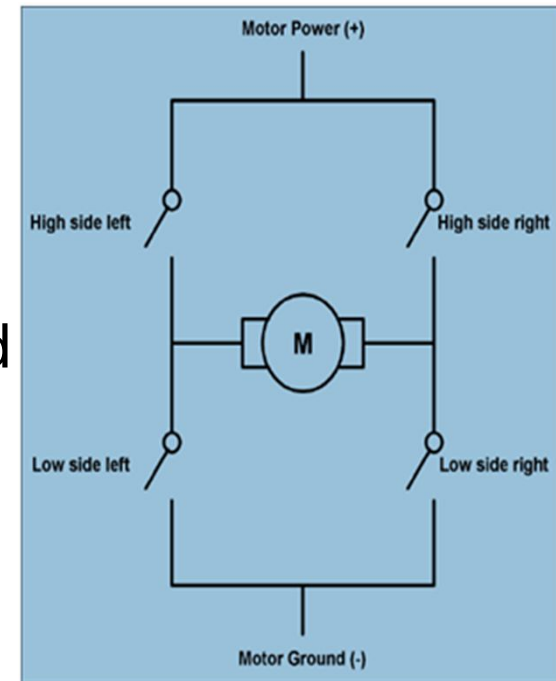
Control Unit

- ▶ Buffered Inputs and Outputs are preferable in control interface
- ▶ Isolation may be required in some cases
 - Optocouplers
 - Relays
 - Use of different Regulated supply



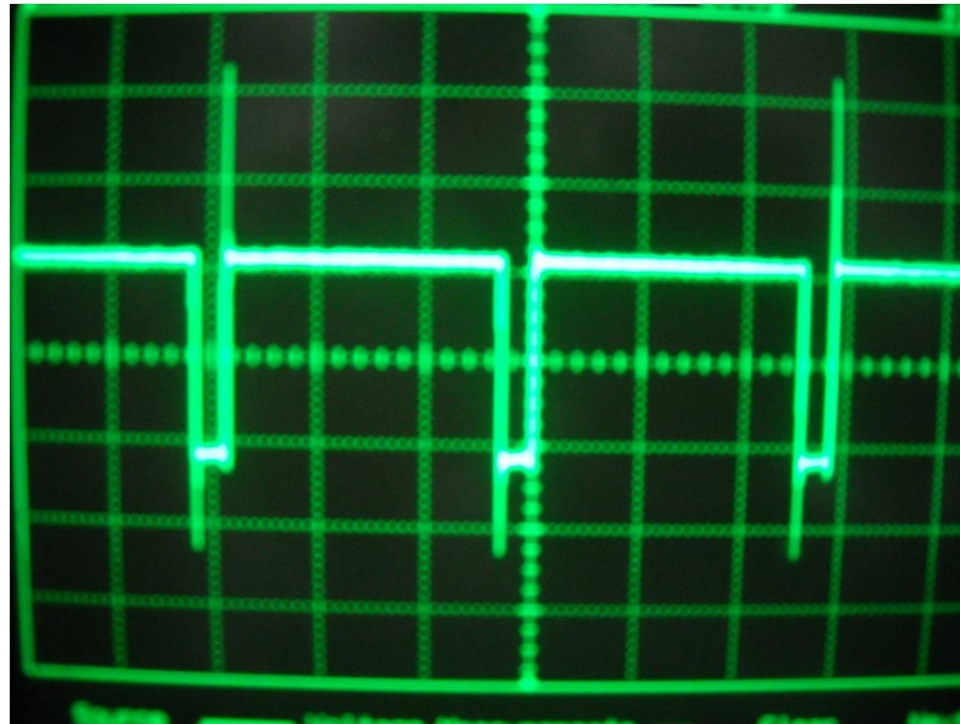
Motor Drivers

- ▶ On/ Off mode
 - Relays and transistors as switching devices
 - Simple
 - No speed control
- ▶ PWM mode
 - Speed control
 - Generally H-Bridge topology used



Problems associated

- ▶ Inductive load produces noise
- ▶ Switching produces transients

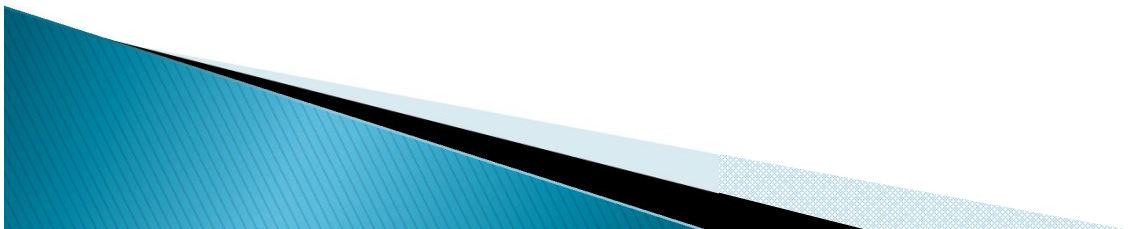


- ▶ Transients can damage the switching elements and create problems in power redgulation
- ▶ Use catch diodes and snubbers to control the transients
- ▶ MOSFET gate driver Ics like IR2110 can be used to switch MOSFETs in H-Bridge topology.
- ▶ Use suitable decoupling capacitor across the motor.



Market places for electronic components in Nepal

- ▶ Annapurna Electronics, Jyatha
- ▶ Bangemuda
- ▶ Real Time Solutions Pvt. Ltd, Tripureshwor
- ▶ Shiva Electronics, Bishal Bazaar
- ▶ Projectronicx Pvt. Ltd, Satdobato
- ▶ www.harilo.com
- ▶ Sundhara and Bhotebahal for electrical components
- ▶ Teku for mechanical tools and machineries
- ▶ Junkyards



Recommendations

- ▶ Use regulated power supply.
- ▶ Use decoupling capacitors for individual ICs.
- ▶ Use indicators especially for power supplies and sensor inputs
- ▶ Do not compromise with the standard of connectors (**Majority of the undefined problems arise due to low quality of connectors**)
- ▶ Update yourself from discrete components to modules
- ▶ Neatness in soldering and breadboarding
- ▶ Regularly visit local market places for updates



THANK YOU

