Project Overview

This project is to help students learn electronics, engineering in an interesting way. Conducting laboratory experiments is said to be the most important process to learn electronic engineering. However, these independent laboratories were designed for years and thus the technology used is not up-to-date. Also, these laboratories are not related to students’ daily life. Therefore, students lack interest in conducting the laboratory experiments, especially the experiments for learning the basic electronic knowledge.

To solve this problem, this project focuses on laboratories of year 1 course in electronic engineering. A series of fun lab modules for engineering students are developed in this project. These modules are combining new technologies and tightly related to students’ daily life. Hence, the interest and the incentive of students will be increased by these modified fun lab modules. 

This project consists of survey and product design. Survey was first conducted to electronic engineering students. Students were asked to give opinion and suggest improvement for the existing lab experiments. The fun lab modules are designed based on the survey. Four modules are developed:

1. H-Bridge
   - Purpose: It is a circuit to drive the motors.
2. Colour Detector
   - Purpose: It is a circuit to detect the colour of the object in front of it.
3. Distance Detector
   - Purpose: It is a circuit to detect the distance of object in front of it.
4. Bluetooth Module
   - Purpose: It is a Bluetooth transceiver with Max2532 decoder

These modules can be combined to become a multi-purpose car. They are controlled by a microcontroller ATmega128. After producing the modules, another survey was done on secondary students. Data is collected and modification is done according to it.

Methodology

This project is an embedded system. All the modules are connected to the microcontroller as follows:

1. Microcontroller
   - ATmega128 is chosen as the main control unit in this project. It consists of both digital and analog I/Os. It has built-in analog to digital converter (ADCs) that can read analog inputs and convert into digital signal. It also has Analog output which is done pulse-width modulation (PWM). There are also three serial communication channels in ATmega128.

2. Motor driver
   - H-Bridge is a circuit which can control the current flowing through a load in either direction. Basically, it consists of four switches which are usually made by NPN or CMOS transistors. It is named H-Bridge as the circuit looks like the letter ‘H’.

3. Light sensor
   - Light sensor is circuit combining both Light emitting diode (LED) and Light dependent resistor (LDR). Light sensor consists of three original colors, red, green and blue (RGB). Different color light is the presentation of different combination of these three original colors. It is represented by a 3-digit number as the table at the right hand side.

4. Ultrasonic sensor
   - The distance detector has a pair of ultrasonic sensors. One of them is for transmitting and another one is for receiving. The sensor measures distance using sound. When an enable signal (a trigger from high to low) is sent from the ATmega128 to the sensor, an ultrasonic (well above human hearing) pulse will be transmitted from the transmitting unit. The output signal is originally low and it is set high at the moment of transmitting ultrasonic. The distance-to-target is determined by measuring the time required for the echo to return. Once the signal reaches the receiving unit, the output signal is set to low again. The situation is shown in the figure above.

5. Bluetooth
   - Bluetooth is an open wireless technology standard for exchanging data over short distances (using short length radio waves) from fixed and mobile devices, creating personal area networks (PANs) with high levels of security. It was originally conceived as a wireless alternative to RS-232 data cables. It can connect several devices, overcoming problems of synchronization. The flow of Bluetooth used in this project is described as follows:

   - Any input by mobile phone and send out through Bluetooth
   - Receive the signal by a Bluetooth module and output digital signal
   - Analyze the signal and output corresponding commands

Result

Surveys and interest classes are held for two different schools, Lok Sin Tong Wong Chong Ming Secondary School and United Christian College (Kowloon East). Totally 78 students with different age groups are invited to perform our project.

The following charts show the results of the surveys.

Which part of the interest class increase your knowledge of the electronic module?

- 68%: All students thought that the interest class can enhance their knowledge about the electronics.
- 69%: Can this interest class enhance your knowledge about the electronics?

- 91%: Can this interest class enhance your knowledge about the electronics?