**Princess Sumaya University for Technology**

**King Abdullah II Faculty of Engineering**

**Embedded Systems Project**



**Bicycle Safety System**

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November 22, 2024

***Abstract***

This project presents a Bicycle Safety System to enhance a cyclist experience and ensure their safety, using the PIC16F877A. The system integrates multiple features, including both a right and left turn signal, which activates yellow LEDs according to the direction. A brake feature using flex sensors, which when bended a certain degree activates the red LED brake lights. The system also includes a speedometer, which displays the speed on an LCD screen. Speed is calculated by measuring the RPM using a hall-effect sensor. In addition, two ultrasonic sensors are used on the left and right, when an object is in close proximity, the ultrasonic sensor detects it and activates a vibration motor, according to where the object is, to alert the cyclist. Finally, a push button was used to enable a servo motor, which rotates the encasing of the LEDs. This report explores the mechanical, electrical and software components of the Bicycle Safety System, and examines the design process, challenges encountered, and recommendations for future improvements.

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# Introduction and Background

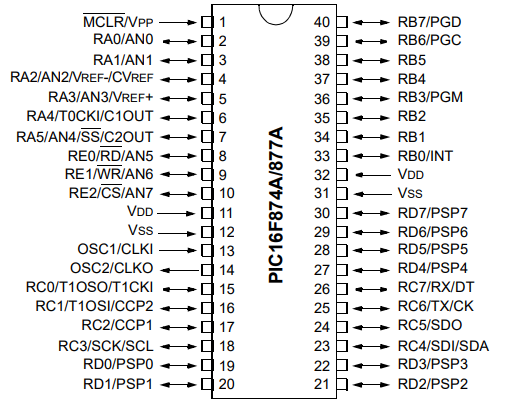
This project explores the development of a Bicycle Safety System which uses the Microchip PIC16F877A microcontroller as its central processing unit.

The main goal of this project is to develop a safety system that addresses the challenges facing cyclists on the road, including difficulty in signaling and vulnerability to surrounding vehicles, in addition to some quality-of-life additions, that include a speedometer.

This report dives into the mechanical, electrical and software details that are implemented to ensure the system is optimized and work perfectly. It also follows the design process, and states the challenges encountered and recommendations for future improvements.

The components used for the project are as follows:

1. **PIC16F877A Microcontroller:** It is an 8-bit microcontroller from Microchip Technology. It features a RISC architecture, with 40 pins, and operates at speeds up to 20 MHz. It has 33 input/output pins, and supports a wide range of peripherals that includes timers, analog-to-digital converters (ADC), and UART for communication. The following figure shows the **PIC16F877A** used with its pins:



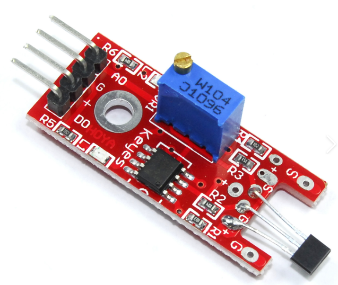
**Fig 1.1 shows the pin diagram of PIC16F877A Microcontroller**

1. **LEDs:** Light Emitting Diodes are semiconductor devices that are energy-efficient, durable, and emit light when electric current flows through. Two LED colors are used in this project, red and yellow, for brake lights and turn signals respectively, with size 5 mm.

**Fig 1.2 shows red and yellow LEDs**

1. **Flex Sensors:** Are variable resistors that change their resistance based on their bending angle. It is an analog device. These are used on the brakes, when a certain degree of bending is achieved, it will light the red LEDs (the brake lights).

**Fig 1.3 shows a 2.2-inch flex sensor**

1. **Hall-Effect Sensor:** detects the magnetic field and converts it to electrical signals. The sensor is used with its module, which integrates it with additional components, such as pull-up resistors. The one we use is digital. This will detect magnets and will be used to measure and calculate the RPM and speed of the bicycle.

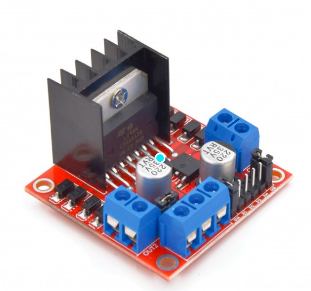
**Fig 1.4 shows the hall-effect sensor and its module**

1. **LCD Screen:** Liquid Crystal Display, used to display information. In this project, the information is the speed.

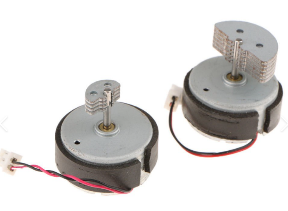
**Fig 1.5 shows an LCD screen**

1. **Ultrasonic Sensors:** Use high frequency sound waves to detect nearby objects. It is a digital device. It triggers then waits for an echo to detect to measure the distance between it and the object. Two ultrasonic sensors are used from either direction to detect nearby objects.

**Fig 1.6 shows an ultrasonic sensor**

1. **H-Bridge:** is an electronic circuit that enables a voltage to be applied across a load in either direction. It consists of four switches that can be toggled to control the flow of current. The H-bridge is used to connect the ultrasonic sensors and the vibration motors to control their speed, and to control which one vibrates.

**Fig 1.7 shows the H-Bridge**

1. **Vibration Motors:** generate tactile feedback by producing vibrations. Two vibration motors are used, each connected to an ultrasonic sensor through the H-bridge.

**Fig 1.8 shows two vibration motors**

1. **Servo Motor:** it is a rotary actuator that can precisely control angular position, velocity and acceleration. It is composed of a motor, a controller, and a position-feedback sensor. It is used to rotate the encasing of the LEDs, where it is rotated so that the LEDs will not show if desired by the cyclist.

**Fig 1.9 shows the servo motor used**

1. **Push Buttons:** Buttons are digital input devices used for user interaction with electronic systems. They are used for the turn signals, to o activate the servo, and the master clear.

**Fig 1.10 shows a tactile push button**

# Project Design

## Mechanical Design

## Electrical Design

## Software Design

# Problems and Recommendations

# 4 Conclusion