CRASH DETECTION SYSTEM USING ARDUINO UNO

Analog Circuits

EL - 213

Date:10/04/2019

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Acknowledgement

It has been a great joy for us to work on the Crash Detection System. It was a really nice experience working on this project and we got to learn a lot. We would like to express our gratitude to all those who have helped us to build our project i.e. Prof. Rutu Parekh and our seniors. This would not have been possible without your intensive support and enthusiasm. Thank you for spending your precious time with us and completely devoting everything for our benefits. Finally, we would like to thank all our fellow colleagues for their great support.

- Team members

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Title:

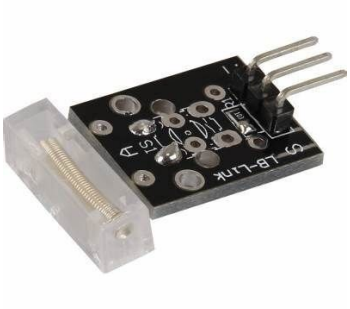
Detect crash of a steady vehicle(not in motion) using sensor of your choice and arduino uno.

Introduction:

In the twentieth century, the number of vehicles exponentially increase due to growth in the automobile industry. As the number of vehicle increases, the number of accidents also increases. The reasons of most of the road accidents are heterogeneous traffic and lack of traffic separation. So an intelligent way of notifying the drivers about the closeness between their respective vehicles is by developing an adept crash detection system which gives an alert to both cars about their closeness and hence whichever driver is active can take necessary actions.
Another use of this system is to detect occurrences such as earthquakes, which can be detected primarily by the vibration sensor, and for alerting against theft, which is primarily detected by the shock sensor.

Components:

1) Arduino Uno



2) Shock sensor

3)Ultrasonic Sensor

4)Vibration Sensor

5) Buzzer

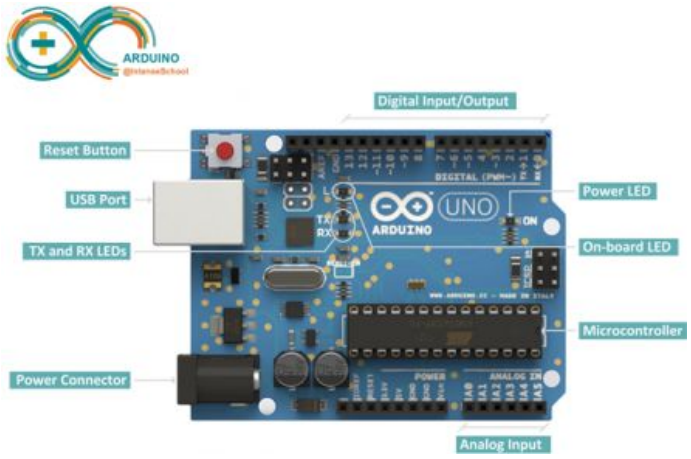
6) Jumper Wires

7)Breadboard

Components details:

1. Arduino Uno

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. The Arduino Uno i on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Arduino project was started in Italy to develop low cost hardware for interaction design. An overview is on the Wikipedia entry for Arduino. With the Arduino board, you can write programs and create interface circuits to read switches and other sensors, and to control motors and lights with very little effort. This is what the Arduino board looks like.



Summary

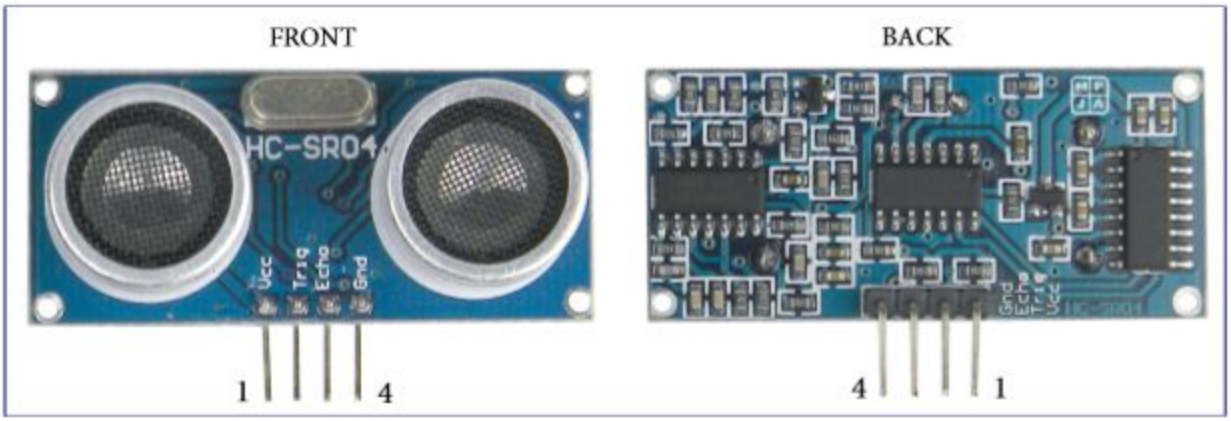
Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
Flash Memory	32 KB (ATmega328)
SRAM	2 KB (ATmega328)
Clock Speed	16 MHz

2. HR-SR04 Ultrasonic Sensor

The transmitter emits a 8 bursts of an directional 40KHz ultrasonic wave when triggered and starts a timer. Ultrasonic pulses travel outward until they encounter an object, The object causes the the wave to be reflected back towards the unit. The ultrasonic receiver would detect the reflected wave and stop the stop timer. The velocity of the ultrasonic burst is 340m/sec. in air. Based on the number of counts by the timer, the distance can be calculated between the object and transmitter The TRD Measurement formula is expressed as: D = C X T which is know as the time/rate/distance measurement formula where D is the measured distance, and R is the propagation velocity (Rate) in air (speed of sound)

and T represents time. In this application T is divided by 2 as T is double the time value from transmitter to object back to receiver.

Component Views

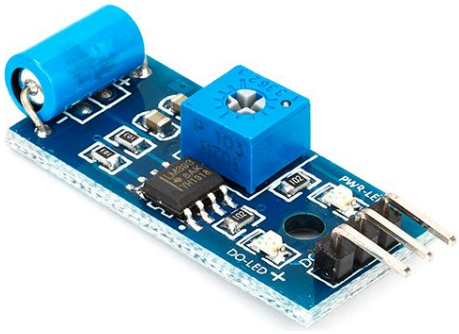


	Pins	**Description**
1.	VCC	5V power supply
2.	Trig	Trigger Input pin
3.	Echo	Receiver Output pin
4.	GND	Power ground
	Electrical Parameters	**Values**

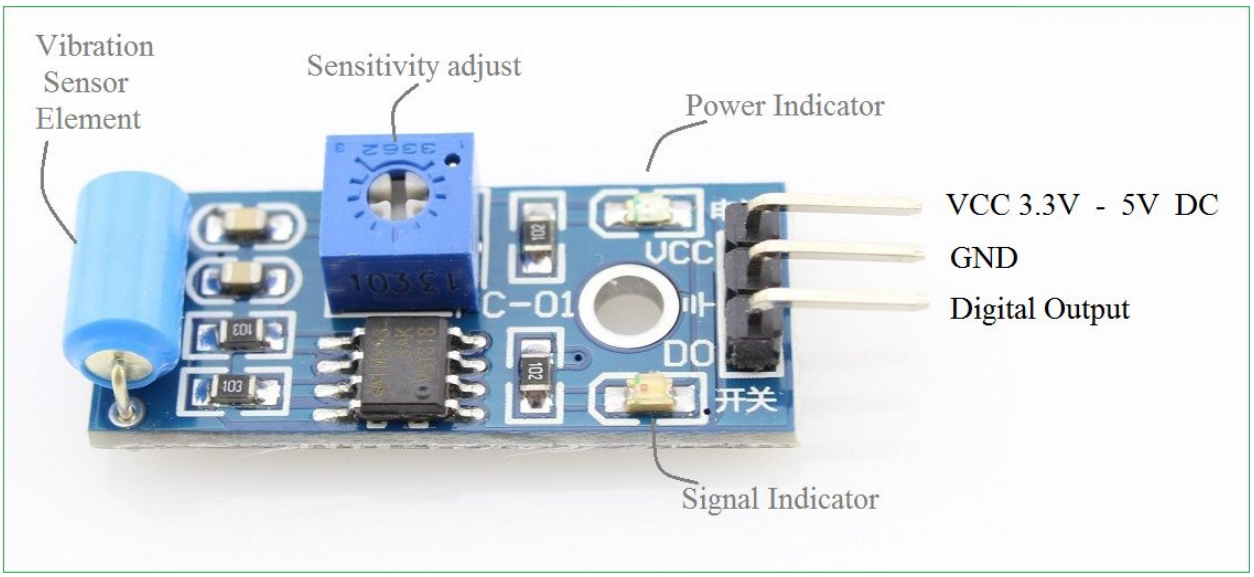
1.	Operating Voltage	5VDC
2.	Operating Current	15mA
3.	Max Range	4m
4.	Nearest Range	2cm
5.	Measuring Angle	15 Degrees
6.	Operating Frequency	40KHz

3. SW-420 Vibration Sensor

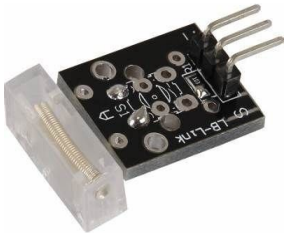
The vibration sensor SW-420 Comes with breakout board that includes comparator LM 393 and Adjustable on board potentiometer for sensitivity threshold selection, and signal indication LED. This sensor module produce logic states depends on vibration and external force applied on it. When there is no vibration this module gives logic LOW output. When it feels vibration then output of this module goes to logic HIGH.



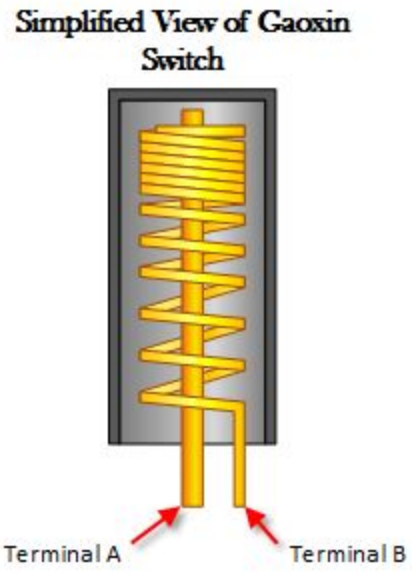
- The working bias of this circuit is between 3.3V to 5V DC.
- Default state of the switch is close.
- Digital output Supply voltage:3.3V-5V
- On-board indicator LED to show the results.
- On-board LM393 chip
- SW-420 based sensor and a normally closed type vibration sensor.



4. KY-031 Shock Sensor



Based on the Gaoxin SW-18010P vibration switch, the Keyes-031 Vibration Sensor allows you to use an Arduino to detect impacts, shocks or shaking. When the switch detects a jolt, the output of the module is sent low.



The KY-031 Vibration Switch Module consists of a conductive vibration spring and a 10k resistor, it will react to shock and vibration by closing the circuit.

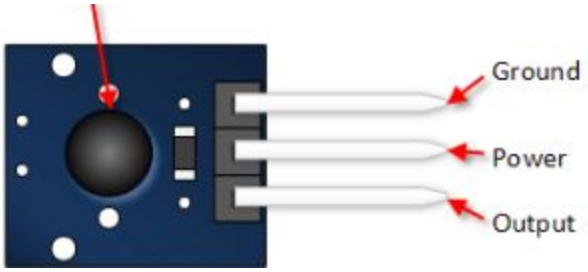
The switch primarily consists of a terminal that forms a center post and a second terminal that is a spring that surrounds the center post. When a

sufficient force is transferred to the switch, the terminal consisting of the spring moves and shorts both terminals together.

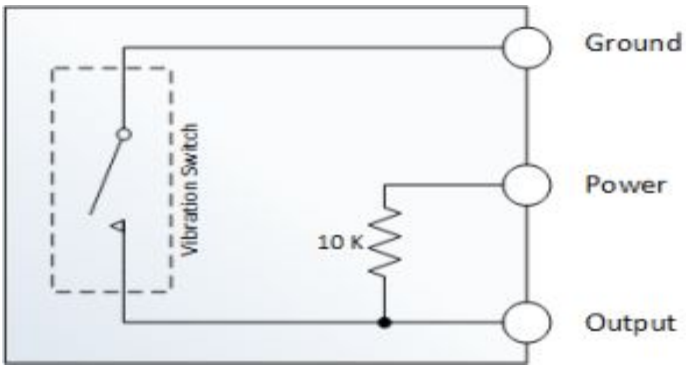
Positioning of the switch is also important. Generally speaking the switch should be physically located as close as possible to the area being monitored. Otherwise, the vibration being detected may be dampened by other structural components in your project.

Parameter	**Value**
Operating Voltage	5-12V
Open Switch Resistance	> 10M Ohms
Closed Switch Resistance	< 30 Ohms
Cycle Life	> 100,000 Cycles.

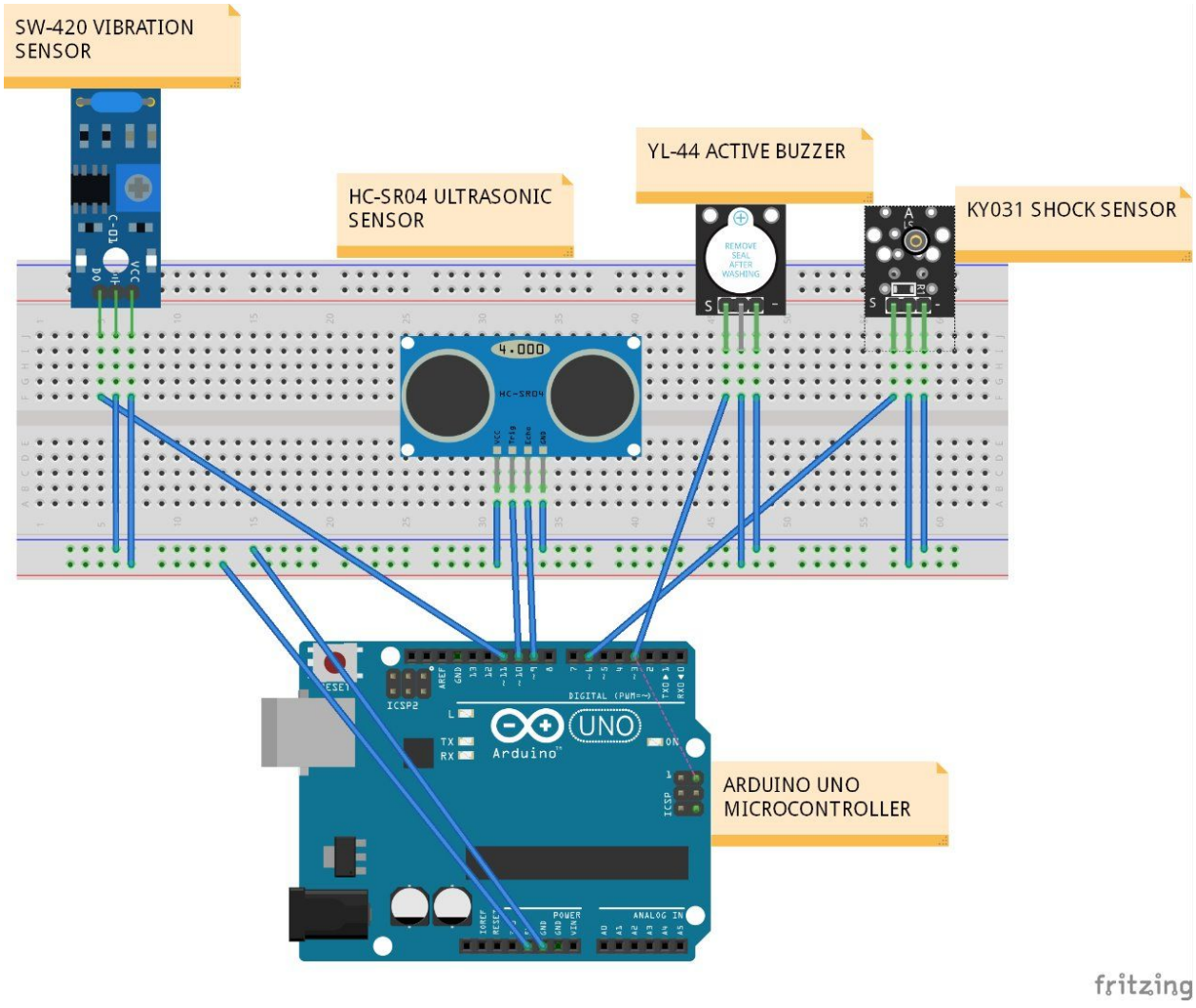
The module only has three connections. They consist of a power input, a ground and an output. These connections are pictured on the diagram on the right.



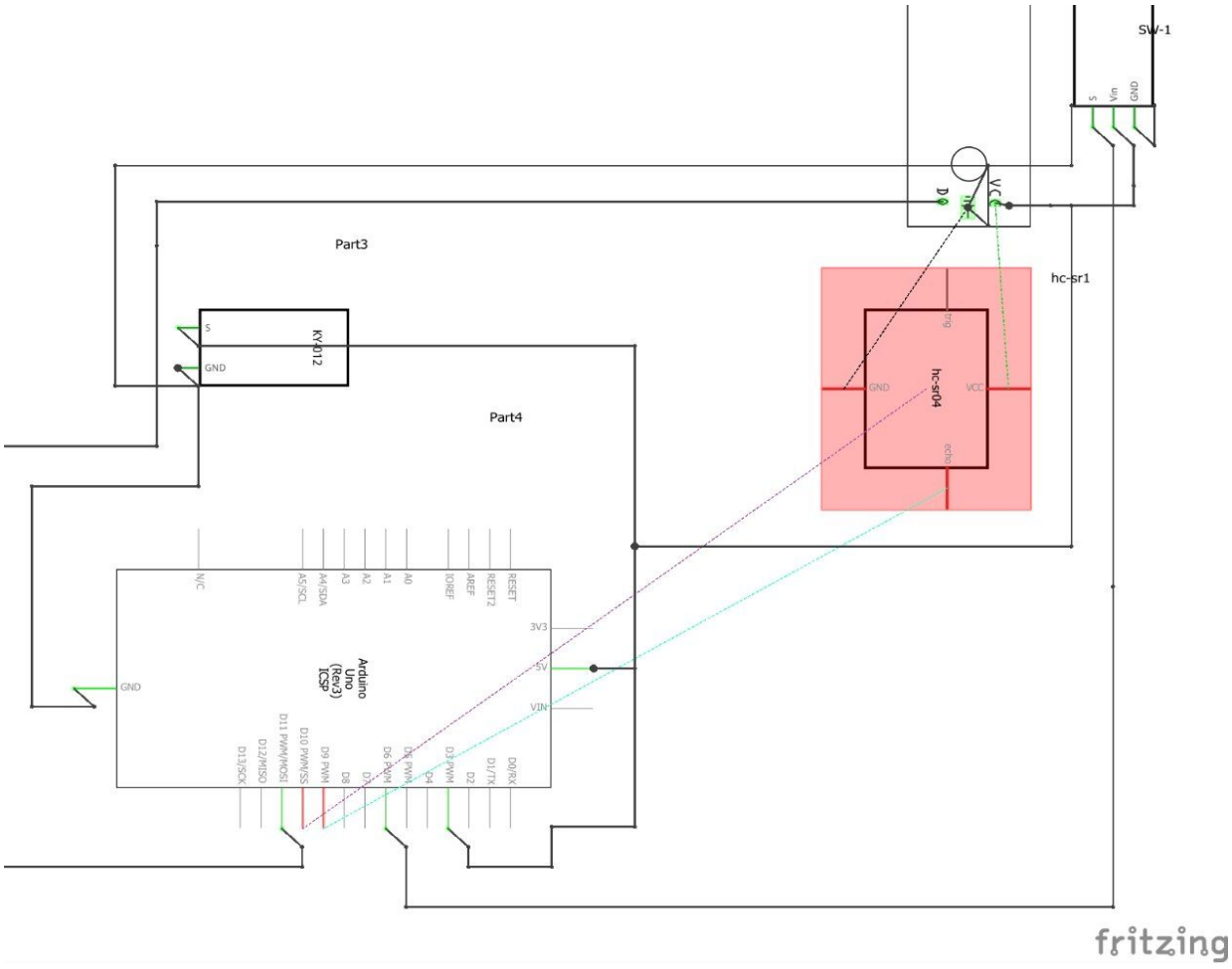
As the schematic on the right shows, the module is nothing more than the switch and a pull up resistor. In fact you could just as easily build your own with the Gaoxin switch alone.



Circuit:


SW-420 VIBRATION SENSOR
HC-SR04 ULTRASONIC SENSOR
YL-44 ACTIVE BUZZER
KY031 SHOCK SENSOR
ARDUINO UNO MICROCONTROLLER
fritzing

Schematic:


SW-1
S
Vin
GND
D0
VCC
Part3
hc-sr1
KY-012
S
GND
Part4
hc-sr04
trig
GND
VCC
echo
Arduino
Uno
(Rev3)
ICSP
3V3
5V
VIN
GND
fritzing

Description and working:

Arduino uno is used as controlling unit in the project with using 3 different sensors resulting detecting a crash successfully. When some shock waves are generated due to some reasons, the shock sensor activates by detecting the shockwaves that are associated with a window or a door being broken. When a large shock wave is detected, the shock sensor will activate. This will tell the shock sensor to send an alert to the alarm system to let it know about the situation. Similarly, the vibration sensor attached in the vehicle will detect vibrations with very high sensitivity compared to shock sensor. With the object coming closer towards the vehicle, Ultrasonic Sensor measures the distance between them by measuring the time between the emission and reception. As soon as the distance is less than zero, ultrasonic sensor is activated sending an alert to the alert system. With the confirmation from all the 3 sensors, one can surely know that the crash has taken place.

Test Results:

The crash detection system is fully functional and working. The 3 sensors attached works upon their principles to send an alert to alert system completing the crash detection process. The sensitivity of model is excellent with having back up sensors for confirmation. The model is strong and simple explicitly built upon the concepts of electronics.

Conclusion:

So finally, using our knowledge of electronic circuits and with the intensive effort of the group members, we have designed a fully functional and efficient crash detection system. The working mechanism of this model is very simple. The 3 sensors attached works upon their principles to send an alert to alert system completing the crash detection process. Given below is a the list of some of the applications where this can be used;

- Collision predictive detection and prevention.
- Burglary protection system.
- Vehicle accident detection
- Earthquake/ Landslide predictive alarm system.
- Smart/ Autonomous Car.

Automated crash alarm systems are already implemented in most of the vehicles today. Our project is just a try at understanding at the basic level how these small but crucial systems work.

References:

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www.elecrow.com

Shock Sensor:
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Ultrasonic Sensor:
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[3] Krishna Kant, "Microprocessor and microcontroller", Eastern Company Edition , New Delhi 2007.