Ultrasonic Distance Sensor

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AIM:

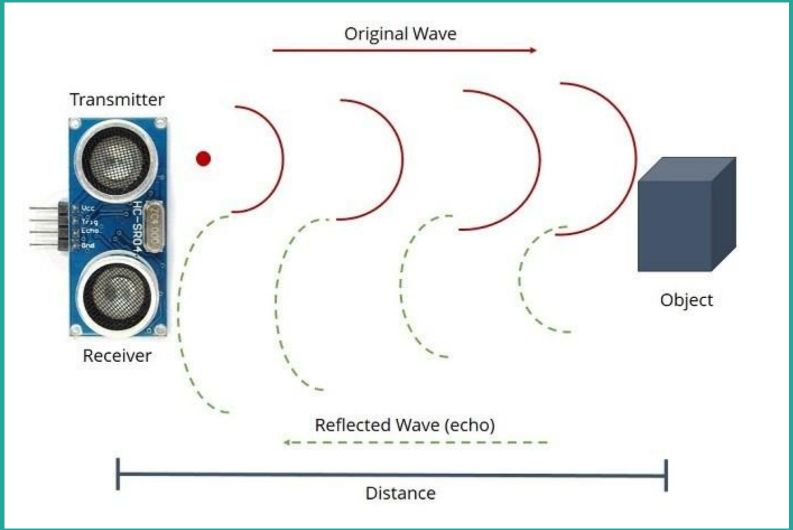
The problem focuses on detecting an object in the vicinity and indicating it's distance. This system can be modified further and used as a security alarm, water level measuring, etc. This can be used in parking lots to detect obstacles. It can also be used for blind people to detect obstacles. We hereby are trying to make a distance sensor without using microcontrollers.

There are three components in the project:

1) Detection component
2) Calculation component
3) Display component

Detection Component

- The ultrasonic receiver-transmitter pair used is HC-SR04.
- The HC-SR04 sensor used sonar to determine the presence of objects. It’s range is from 2cm to 400cm.
- The transmitter sends a signal of high frequency (about 40 kHz) , when the signal finds an object it is reflected and the receiver pair (echo pin) of the sensor receives it.
- The signal to trigger the transmitter must be around 40kHz in frequency. It sends 8 pulses when triggered.
- The signal can be designed using the 55 timer in astable mode at 40kHz frequency.



Calculation component

- The problem is to convert the echo output into Binary coded decimal.
- Maximum range is 4 meters, so if I make a clock of 400 micro seconds then my maximum binary coded decimal value will be 58.
- The formula to be used is Distance=(400 x count)/58 cm , where sound speed is 340 m/sec.

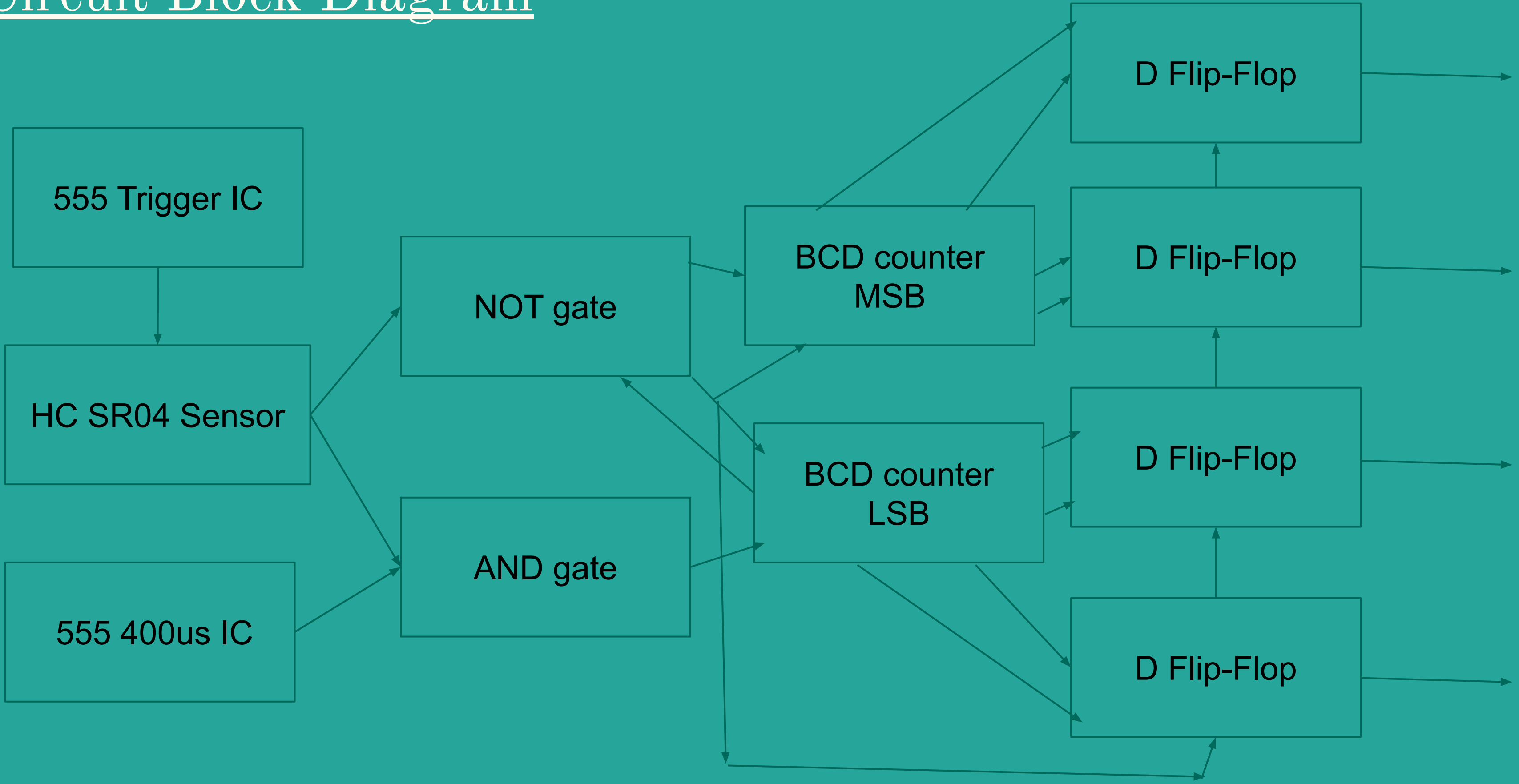
Display component

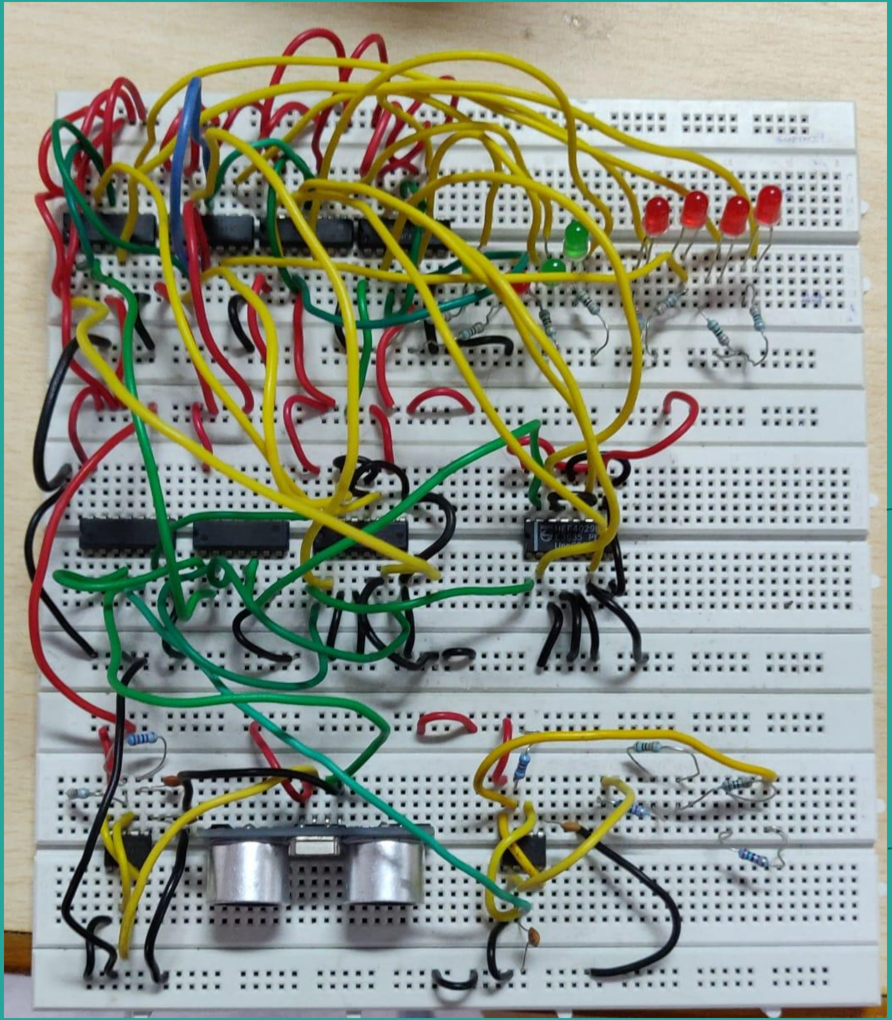
- The output from the calculation component is fed into the counter to count the number of bits.
- The output of the counter changes very rapidly due to the clock being in microseconds.
- Thus we add a set of flip flops at the end to make them stable.
- The output is connected to a set of LEDS.

Components

- HC SR04 sensor
- Two 555 ICs
- One AND gate (7408)
- One NOT gate (7404)
- Two BCD counters (4029)
- Four D Flip-Flops (7474)
- Eight LEDs, Resistors and Capacitors

Circuit Block Diagram





- 4 D Flip Flops
- 8 LEDs

- One AND gate
- One NOT gate
- Two BCD counters

- One 555 timer with 10us clock.
- One 555 timer with 400us clock.
- HC SR04 sensor

Description

- ➔ The 555 trigger IC triggers the sensor to release 8 pulses.
- ➔ The reflected output from the echo pin is put into AND gate with 400us clock from another 555 IC.
- ➔ The output of AND gate is put into the LSB BCD counter.
- ➔ The Reset of the LSB BCD counter is the NOT of the echo output of the sensor, which means it should not count when echo output is HIGH.
- ➔ The Carry out of the LSB BCD counter is put into the NOT gate and it’s output is used as clock for the MSB BCD counter, whose reset is also NOT of the echo output.
- ➔ The output of the counters is fed into the D Flip Flop whose clock is the NOT of the echo output so that the value changes only after the counting is over.
- ➔ The output of the flops is given as input to the LED.

Results and Challenges

- The output on the LEDS is the distance of an object from the sensor.
- Error in computation is about 6.9cm.
- The output is not very stable due to the environmental disturbances affecting the sensitivity of the sensor.
- As the distance increases from the sensor the output becomes less stable.