

CSE 360: Computer Interfacing

Project Title: Intrusion Detection System

Section: 03

Group: 03

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Introduction

An Intrusion Detection System (IDS) is a security system that monitors and analyzes activity in the system's area to find and report any malicious or strange behavior.

Arduino, an open-source microcontroller platform which is used to build a wide range of electronic gadgets and systems. Arduino is comparatively cheap, so that it is used for small-scale applications because of its small size, little power consumption. For building small sized IDSs which only works for a few sensors and some essential components, Arduino is enough to build. It is capable of being designed and built with sensors like motion detectors, temperature sensors, and proximity sensors to identify intrusions. Building IDS with Arduino is beneficial because of its easy modification property, cheap cost and ease of use. Security also can be implemented on this system to protect from hackers by firewalls, antivirus. Whenever any security breach occurs, IDS sends a warning to staff. To conclude, an Arduino-based IDS is effective and cost-efficient for preventing small scale intrusions for home and small businesses.

Application Area

Intrusion Detection Systems (IDS) are used to detect intrusions and give warning to security management about possible security breaches. This system can be used in small-scale security such as home security or small businesses.

Technology & Tools

1. Arduino Uno R3 SMD

Arduino Uno, a microcontroller which is used to analyze the data gathered from the connected sensors and will provide an output based on how it has been programmed.

2. Ultrasonic HC-SR04 Sensor

This sensor uses sonar to detect objects within a range of distances, or 0.02 to 4 meters. It uses little power and is incredibly simple to interface.

3. PIR Sensor

PIR sensor is used to detect any entry or leaving of human or animal in its field. This sensor is used in modern security systems or any automatic light switches etc to get the response of motion.

4. OLED Display

OLED stands for Organic Light Emitting Diode. An OLED display uses organic compounds to create light. Organic materials that make up OLED displays emit light when an electric current is passed through them. Some of the characteristics of OLED displays are deep black levels, high contrast, and wide viewing angles. They are perfect for usage in mobile devices like smartphones and tablets because they have quick response times and require less power than conventional LCD displays.

5. Buzzer

A buzzer made by Arduino is similar to a beeper. When an electric current is fed through the Arduino buzzer, it emits sound. The buzzer may be connected directly to the Arduino and given various frequency electric pulses to make various tones.

6. MB102 Breadboard

Circuits with easily replaceable components are constructed on a breadboard. To connect the components in this case, soldering is not necessary.

7. SG90 Servo Motor

A tiny DC motor used inside servo motors regulates motion.

8. Softwares

Arduino IDEs have been used for designing. The programming language used here is C. Tinkercad is used to design the circuit and its connections. Packages like "NewPing by Tim Eckel" are used for HC-SR04 Ultrasonic Sensor, "LiquidCrystal I2C by Marco Schwartz" for 16x2 LCD display, Servo package used for servo motors, and Servo library to control the operation of servo motor.

Working Mechanism of Sensors

1. HC-SR04 Ultrasonic Sensor

The HC-SR04 ultrasonic sensor is constituted of a receiver and a transmitter. The function of the transmitter is to produce 40 KHz ultrasonic sound pulses by converting the electric signal. The function of the receiver is to receive these pulses, and to create an output pulse. The width of these pulses are usually proportional to the distance of the object placed in front. So, an obstacle located at 2 cm to 400 cm can easily be detected by using this sensor with an accuracy of 0.3 cm.

2. PIR Sensor

The sensor that is used to detect changes in the amount of infrared radiation reflected by objects present in its field of view is known as passive infrared (PIR) sensor. The pyroelectric material that has been used to make this sensor, generates a voltage when there is variation in infrared light. To detect the movement this energy is to be boosted and put through a computer. PIR sensors are basically used to sense motion in security systems, automatic lighting, and other places. To find any moving things that are warmer or cooler than their surroundings, like people, animals, and cars this PIR sensor is the best device to use. The sensor can work in the dark and does not give off any radiation due to its built-in inactive sensor.

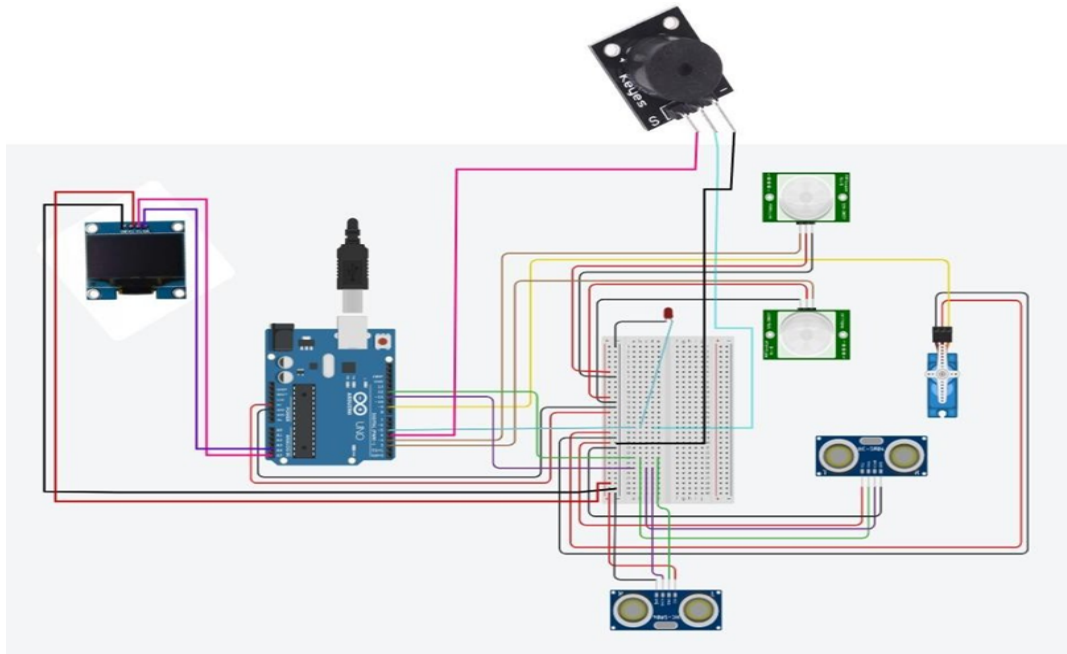
OV7670 image sensor

The OV7670 image sensor is a low voltage CMOS sensor that offers full single-chip VGA camera and image processing functionality in a compact size. Through the Serial Camera Control Bus (SCCB) interface, the OV7670 provides full-frame, sub-sampled, or windowed 8-bit images in a variety of formats. This product has an image array that can operate at up to 30 frames per second (fps) in VGA.

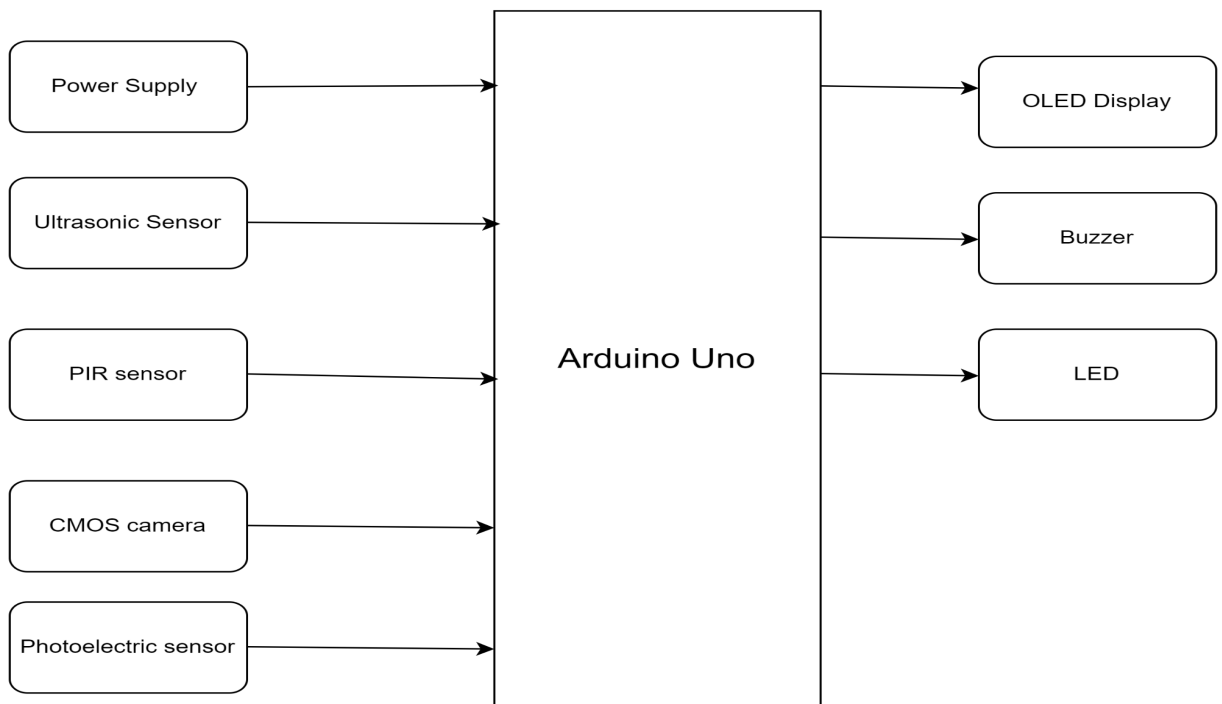
The Omran photoelectric sensor

It may be used to find items and obstacles that are 5 to 100 mm away. The sensor has an LED that is constantly off and only illuminates when it senses an obstruction. The potentiometer on the sensor can also be used to modify the LED's status. (In other words, the LED is always on and will switch off when the obstruction is found.) Another potentiometer on the sensor can be turned in order to modify the sensitivity of the device (increasing or decreasing the detection range). When an obstruction is found, the output goes from LOW to HIGH, and vice versa.

Connection with ICs



Data Flow



HC-SR04 Ultrasonic Sensor

Triggered by the Trig (trigger) pin, ultrasonic sound pulses are connected to Arduino Uno's digital pin 12. Through holding this pin HIGH for 10 μ s, the sensor starts an ultrasonic burst. The echo pin goes high when the ultrasonic burst is transmitted, and stays high until the sensor gets an echo, at which point it drops low. The analog pin 11 of the Arduino Uno connects to the echo pin. The distance is determined by counting the number of seconds the echo pin remains elevated. It will detect and display a signal for the presence of an intruder when the distance between the intruder and ultrasonic sensor is close enough.

PIR Device

The PIR sensor is made up of 3 pins. These are: H - VCC, GND and OUTPUT pins. The signal from the PIR sensor sends out through the OUT pin. When the sensor recognizes motion, this pin will go up, which indicates that a motion has been detected. Any digital pin on the Arduino can be linked to the OUT pin. In our project, Digital Pin 3 and Digital Pin 2 are connected to the Out pin.

The VCC pin connects to the 5V pin of Arduino UNO, which takes in power input to operate. The ground (GND) pin of the PIR sensor connects with the GND of Arduino UNO to complete the circuit.

OV7670 image sensor

The OV7670 image sensor is a low voltage CMOS sensor that provides the full functionality of a single-chip VGA camera and image processor in a small footprint package. The OV7670 provides full-frame, sub-sampled or windowed 8-bit images in a wide range of formats, controlled through the Serial Camera Control Bus (SCCB) interface. This product has an image array capable of operating at up to 30 frames per second (fps) in VGA.

OLED Display

Four pins are found in the OLED panel - +VCC, SDA, SCL, and GND. The sensor derives its power from the 5V pin on the Arduino Uno, linked to the Vcc pin. Ground Pin links itself to GND. The A4 and A5 pins can be linked to the SDA and SCL pins. When both PIR sensors sense movement, the OLED display can, then, start to show a count for each person's entrance. If someone leaves the room, the OLED will decrease the count on the OLED display.

Buzzer

The buzzer generally has three pins. These are VCC, GND and Control Pin. The buzzer's control pin will be linked to the Arduino board's digital 4 output pin in this project. Vcc connects to the 5V pin on the Arduino Uno. The GND pin of the buzzer connects to the Arduino board's ground (GND) pin. In case an intruder is detected, the buzzer will get on and will make a beep sound.

Servo Motor

Three cables connect to a servo motor to an Arduino board: power, ground, and control data. In order to power the motor, the power and ground wires are connected to the Vcc and GND pin on the board. The control signal must be connected to digital output pin 9 in order to control the motor's position. In terms of our project, the red wire is connected to Vcc, while the brown ground wire is connected to the Gnd pin on the Arduino board. After 20 seconds, in case an intrusion is detected, the motor will proceed to close the door permanently.

LED

LED (Light Emitting Diode) may be attached to any digital pin on Arduino. Pin 13 can be described as the most frequently used digital pin for connecting an LED, as it is typically connected to the LED on the Arduino board. In order to attach an LED to an Arduino, we need to connect the anode (long leg) of the LED to a digital pin on the Arduino and the cathode (short leg) of the LED to a ground pin on the Arduino board. Positive terminal will be attached to Digital Pin 2 in this procedure. If an intruder is present and the buzzer sounds, the led illuminates itself simultaneously.

Estimated Cost Analysis

Component	Quantity	Price (BDT)
Arduino Uno R3 SMD	1	860
HC-SR04 Ultrasonic Sensor	2	180
PIR Motion Sensor	2	160
640x480 CMOS Camera	1	861
Omran photoelectric sensor	1	450
OLED Display	1	345
Mini Servo SG90	1	138
MB102 Breadboard	1	145
Buzzer	1	59
On/Off Switch Mini	1	6
5 mm Red Led	5	5
Jumper wire: Male to Female	100	100
Jumper wire: Male to Male	100	100
	Total cost	3419

Responsibilities of Each Member

Name

Md Moshior Rahman
Akhlak Ur Rahman
Ayash Hossain Chowdhury
Nisarga Bala
Mirza Eshraq

Responsibility

Report writing and circuit connections
Coding and circuit connections
Report writing and circuit connections
Coding and circuit connections
Report writing and circuit connections

Gantt Chart



References

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