ULTRASONIC ZONAL OCCUPANCY DETECTOR

Team Name: Energy Hunters

Team members:
Deepak Ranjan Swain
Mayuri Khardikar
Monami Mitra
Pallab Kumar Sahu

Title:Ultrasonic Zonal Occupancy Detector

Problem Definition:
Occupancy detection using ultrasonic sensors for detecting occupied zones in a place, visualizing them in real time and controlling the electrical appliances accordingly.

Motivation:
Often we see that in our institute,IIT Bombay lights are turned on for whole class room while only half or one-fourth of the class is occupied by the students. From this observation we thought of devising a system for automatically controlling electrical appliances as per the occupancy which will in turn save a lot of energy. In order to do so we need to detect occupancy of the zones. Some occupancy detectors are implemented using PIR (motion sensor) sensors which has the problem that they can't detect static/still occupants (False-Off problem). Another implementation is associated with image processing, but that comes with pretty large cost overhead. So it was time to come up with a cheap yet effective solution.

Highlights of the project:
Simplicity
Cost effectiveness
Scalability
Repeatability
Data visualization
Learn-ability

Implementation:
We developed a zonal occupancy detecting system based on cheap ultrasonic sensors. The system contains four ultrasonic sensors mounted on a square platform (see the figure no. 1). Each sensor senses the occupancy of single zone. Based on the occupancy of any zone we can control the electrical devices of that zone, that is if nobody is present in any zone, our system will switch off the electrical devices such as lights,fans etc. of that zone keeping all other zone turned on. In case of large rooms when room dimension is larger than the sensing range of the sensors we can increase the number of sensors in the room. Our system is independent of configuration changed of the room (like movement of chairs/tables) as system has the capacity of learning the room structure within 2 seconds. We have also shown real-time zonal occupancy data on a html page. This information can be used for maintaining security concerns in an area.

For our implementation we have used the following hardwares

1. Arduino Mega 2560	(1 nos)
2. HC – SR04 Ultrasonic Sensors	(4 nos)
3. LED	(4 nos)
4. Bread Board	(5 nos)
5. Connecting Wires	

The circuit diagram is given in figure 3. In the circuit diagram we have shown just one HC-SR04 Ultrasonic sensor for simplicity. We need to connect the rest of the ultrasonic sensors accordingly. Each LED depicts the occupancy of a zone and also the fact that the devices are ON in that zone. When a LED is on, it means that the electrical devices in that zone are ON. Instead of lighting the LEDs we can use the output from Arduino board to feed the same into a relay to control the electrical devices.
The file named 'us_sensor_zones.ino' was used with Arduino Mega 2560.
The file named 'print.py' reads the data from the serial monitor supplied by Arduino and generates the web page named 'myhtml.html' to give real-time visualization of zonal occupancy.
The file named 'myhtml.html' is a html file which is refreshed every two seconds to show real-time real zonal occupancy.

In order to build the system keep all the code files and image file in the same directory in same directory and follow the steps given below.

1.Verify and upload the code "us_sensor_zone.ino" on adruino board.
2.Open the file "myhtml.html" in any browser of your choice.
3.Run the python script from terminal using command "python print.py".

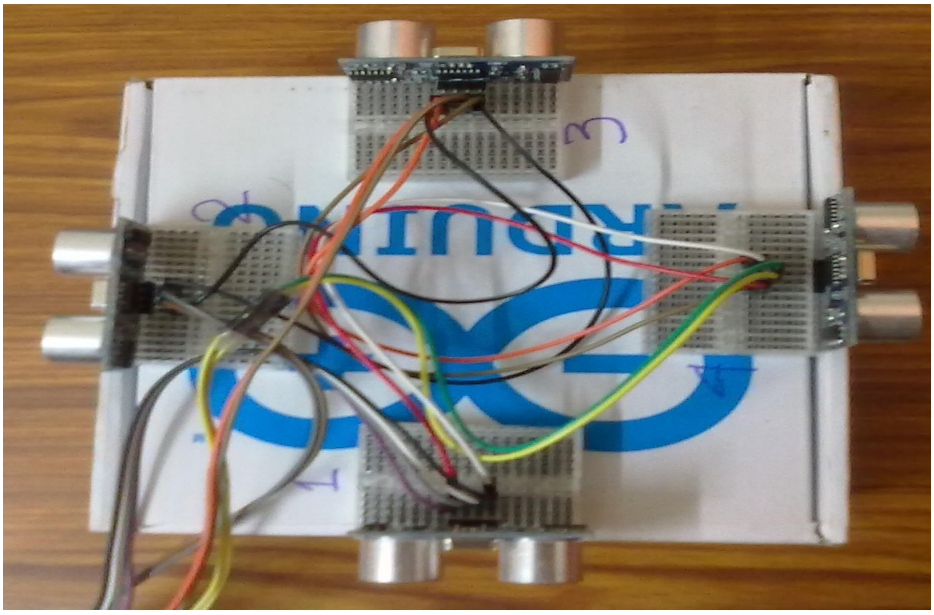

Figure 1:Picture showing four sensors mounted on a base

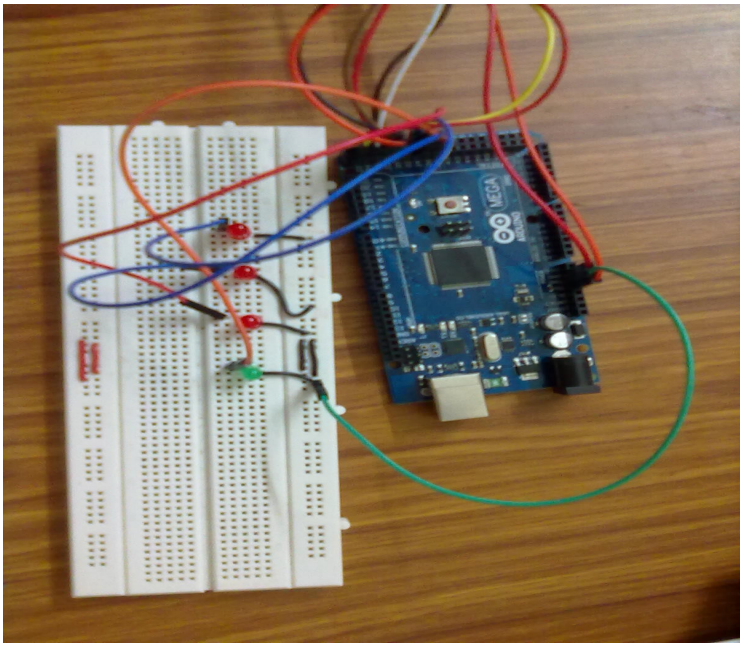

Figure 2: Picture Arduino Board and LEDs

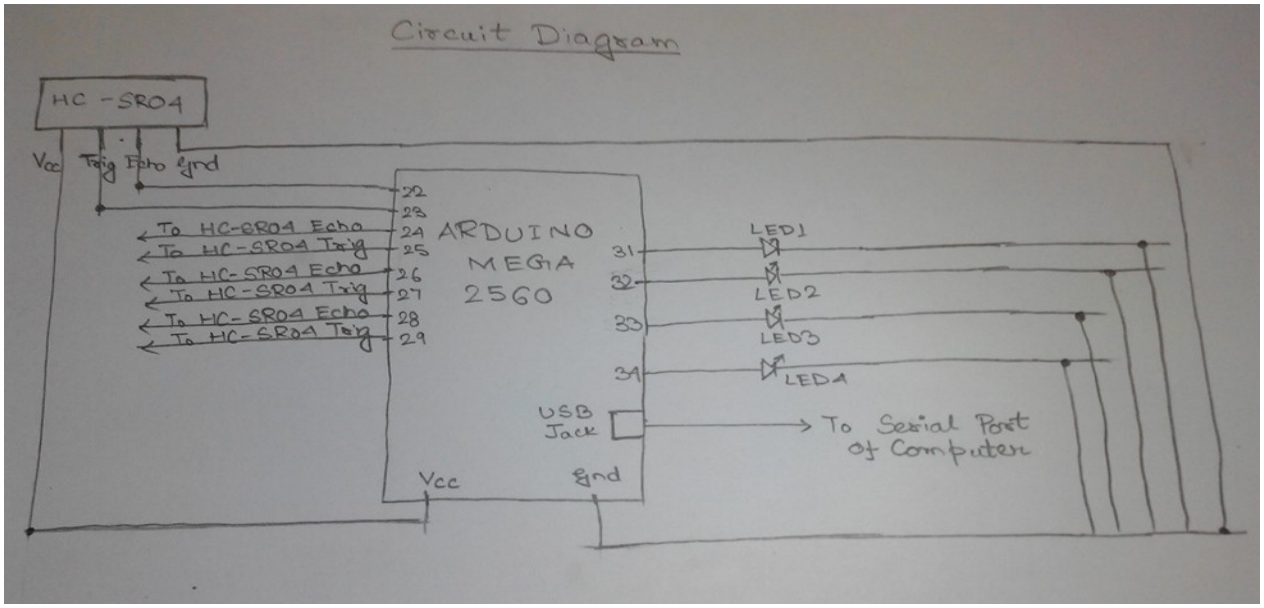

Figure 3: The circuit diagram

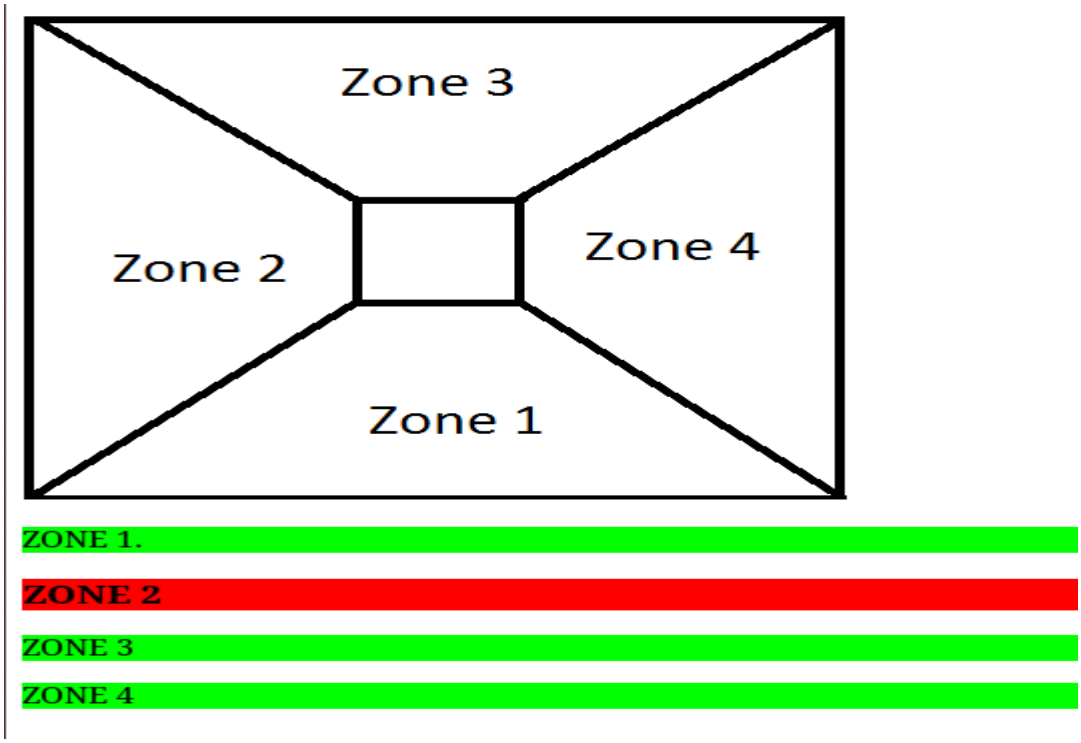

Figure 4: Screen shot of the web page showing zonal occupancy.
Zones in green color indicate no occupancy while the ones in red indicate some occupancy

For further queries contact:
pallabksahu@gmail.com
swain.deepak014@gmail.com