Internship Report

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Abstract

The Arduino's sensors can provide a wide range of information, which can be used to infer the behaviour patterns. Thus, the integration of the data captured provides the achievement of multiple applications, such as air conditioning regulation, security access and people management in a working environment.
In this research, it is proposed the implementation of a person counter and weather station to do a correlation between weather and people using different entrances of a place. We use two ultrasonic sensors for each Arduino station to permit us to identify and count people who leave or enter in certain place, and a weather to measure data like temperature or humidity and SD plug-in to record these data. Some limitations due to ultrasonic sensors accuracy were also identified in order to clarify the scenarios where those devices can be used.

INTRODUCTION

The effect of weather on people, like in people's daily activity patterns are significant, for example a study proves that on days that are very cold (–5°C to 5°C), or calm (i.e., wind speed is less than 2 km/h), people were more likely to stay longer and spend more time at areas that consists of eateries and food outlets such as restaurants, cafés etc.…
So we try to establish a correlation between the climate condition and laboratory user pattern's. To do this, we measure the number of outgoing and ingoing person on the lab, to do this we are going to use a system including an Arduino UNO, two ultrasonic sensors because 2 sensors of this type permit us to differentiate the entrances and the exits; for example, if a person crosses by the first ultrasound (the closest of the door) and the second one, we will increment the value of people in the laboratory (with pointers).

We combine this people counting value with weather measurement with the help of the sparkfun weather and sparkfun libraries, which can monitor temperature, humidity, pressure and light level, this value are convert into CSV format and saved on the SD card through the SD bee every 10min.
With all this values, we would make a correlation using CSVkit.

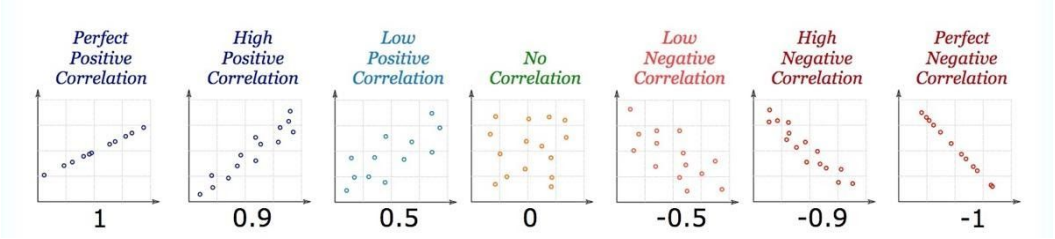


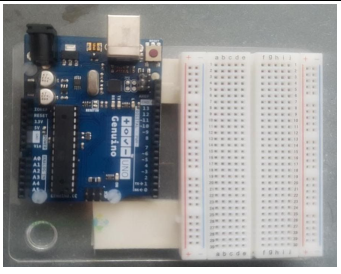
Figure 1 examples of correlation

RESSOURCES

HARDWARE

Sensebox Edu Kit[1]

A do-it-yourself kit for stationary and mobile sensors. Permits to monitor environmental data on climate, air quality, traffic, noise, and more position-related and thus contribute to more accurate statements about local environmental phenomena.



Arduino UNO with breadboard

Arduino UNO is a widely used open-source microcontroller board based on the ATmega328P microcontroller and developed by Arduino.cc
The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shieldse) and other circuits. The board features 14 Digital pins and 6 Analog pins. It is programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable.

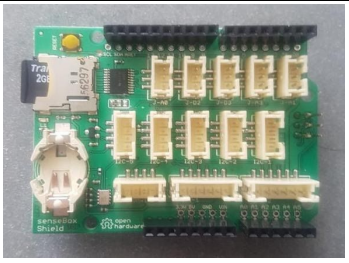
[1] https://sensebox.de/

The breadboard permits to extend the connection.

HR-SR04 ultrasonic transceivers sensors (x2)

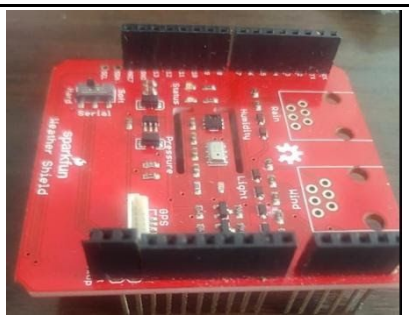
Ultrasonic sensors are a type of acoustic sensor divided into three broad categories: transmitters, receivers and transceivers. Transmitters convert electrical signals into ultrasound, receivers convert ultrasound into electrical signals, and transceivers can both transmit and receive ultrasound.

In a similar way to radar and sonar, ultrasonic transducers are used in systems which evaluate targets by interpreting the reflected signals .We will use two for each Arduino system.



A SD plug-in (sensebox SD bee)

The senseBox-Shield is a plug-in board developed by the senseBox team together with Watterott electronic. On the shield is a SD card slot (via pin 4) and a real-time clock RV8523 with battery installed. In addition, I2C slots for the senseBox: home sensors are soldered, which are not needed for the senseBox: edu. Since the SD card slot occupies pin 4 and 10, they are no longer usable by default



A sparkun weather BEE

The Weather Shield is an easy to use Arduino shield that grants access to barometric pressure, relative humidity, luminosity, and temperature. There are also connections to optional sensors such as wind speed/direction, rain gauge, and GPS for location and super accurate timing.

Software

- **Github:** web-based hosting service for version control using Git. Used for arduino code. It offers all of the distributed version control and source code management.
-**Tinkercad Circuit** : Autodesk software used to make simulation and scheme.
- **Google Drive :** used for cloud working, principally the word processing Google Docs.
-**Arduino IDE :** It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus.
The Arduino IDE supports the languages C and C++ using special rules of code structuring.

Arduino libraries

- NewPing library[2]: used to manage the ultrasensor
- SD libraries[3]: to save data on SD card
-SparkFun libraries[4]: for the weather sensors.
- Wire library [5]: for circuit wire

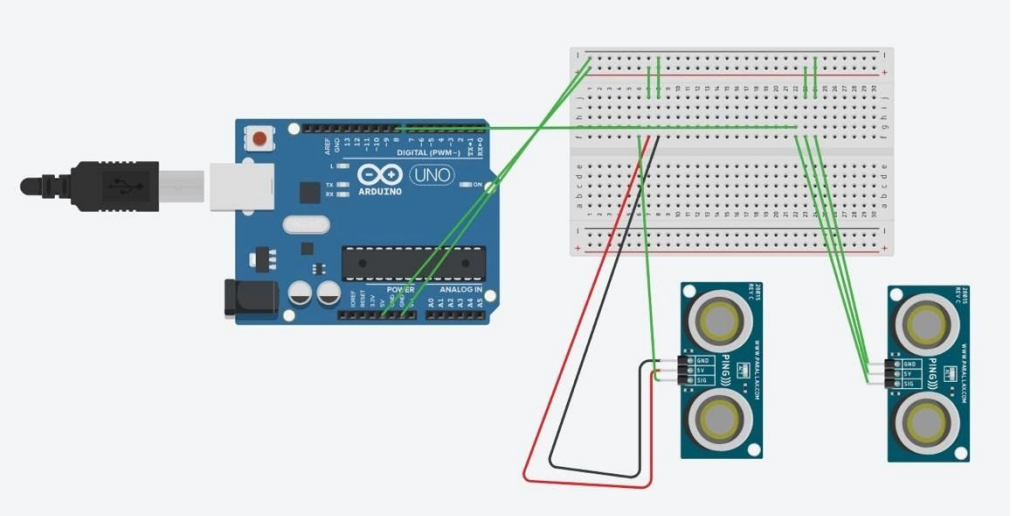
[2] https://playground.arduino.cc/Code/NewPing
[3] https://www.arduino.cc/en/Reference/SD
[4] https://learn.sparkfun.com/tutorials/weather-shield-hookup-guide
[5] https://www.arduino.cc/en/Reference/Wire

IMPLEMENTATION

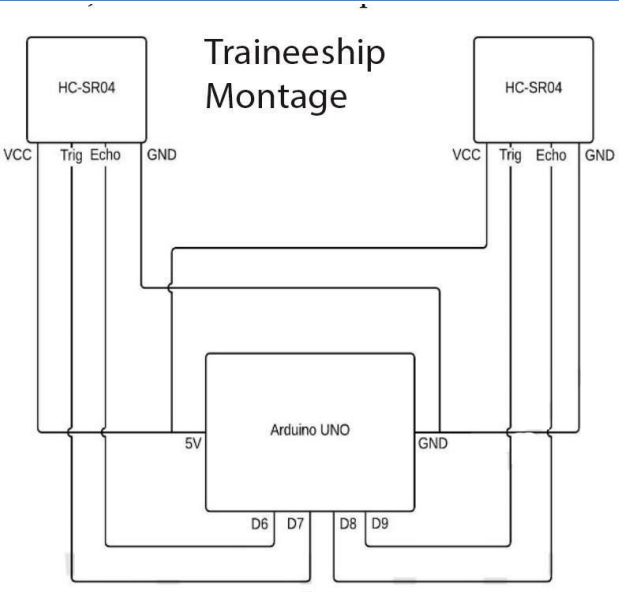
HARDWARE IMPLEMENTATION

We plug the 4 pins of first ultrasonic sensor and the 4 pins of the second ultrasonic sensor on the breadboard, and we rely the 5V and the Ground of the Arduino to the appropriate column of the breadboard (+ column for the 5v and – column for the gnd) and we connect each trigger and echo pin to the digital entrance of the Arduino (with a SD and a weather sparkfun plug-in bee both connected on the Arduino)

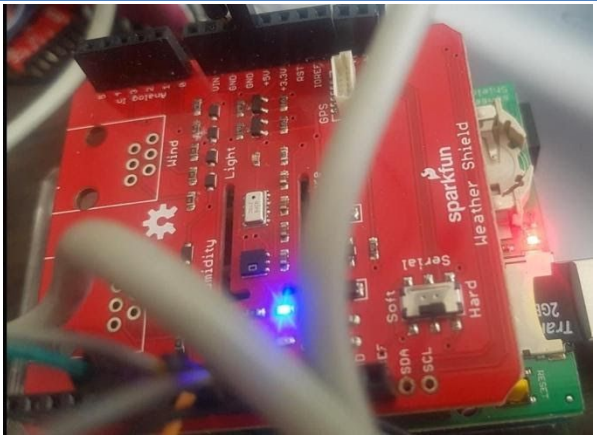
1)TINKERCAD CIRCUIT



2) ELECTRIC MONTAGE



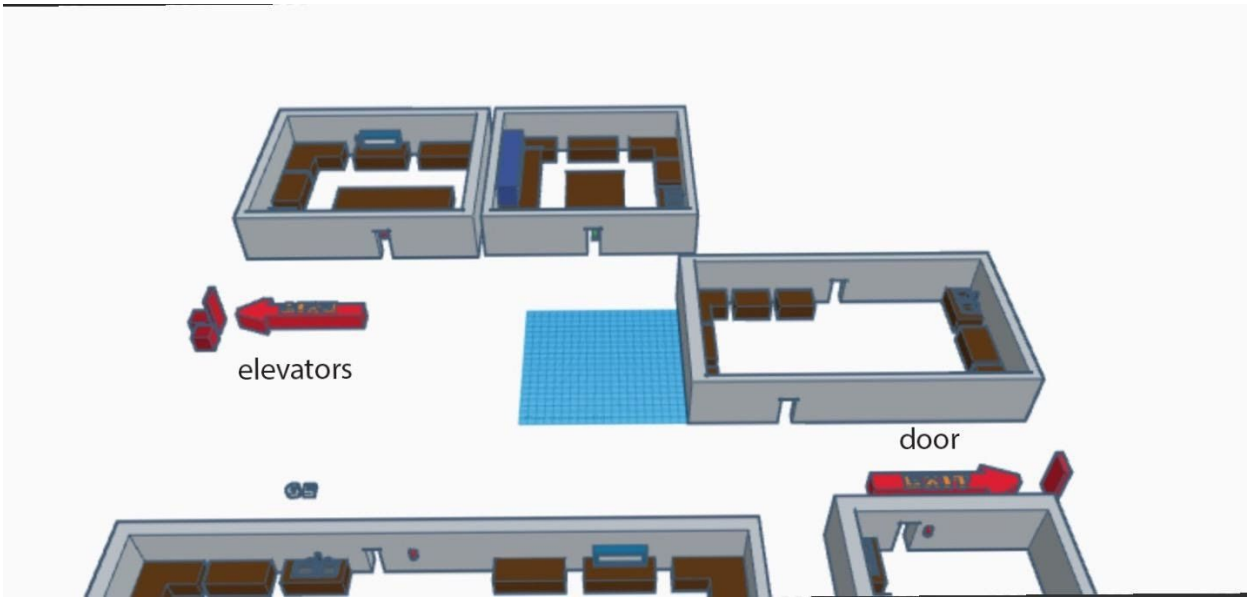
3) SD PLUG-IN AND WEATHER PLUG-IN



The SD plug-in is plugged on the Arduino UNO and the weather plug-in is plugged on the SD plug-in and all the connection to the breadboard are made on the weather plug-in, we have to check which plug-in use which Arduino PIN to don't reuse these pin.

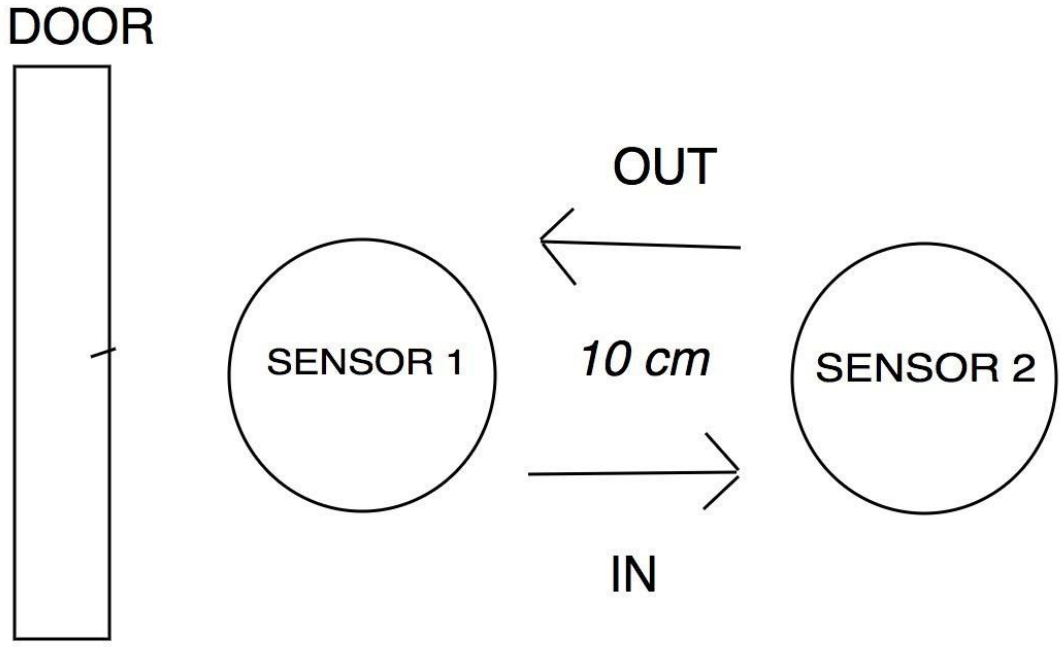
4) INSTALLATION

We count people and collect weather data in two place: the main door entrance, and the elevators.



The installation is stuck to the wall thanks to the adhesive strips:

5) Counting with ultrasonic sensors



If someone pass trough ultrasonic sensor 1 then ultrasonic sensor 2, the “in” value is increment.
If someone pass trough ultrasonic sensor 2 then ultrasonic sensor 1, the “out” value is increment.

SOFTWARE

Count part

-checksensor : to identify which ultrasonic sensors find someone and return 0 or 1 , with the sensor by measuring the time between sending a signal and receiving an echo the distance of an object can be calculated, it’s based on the trivial equation $distance = speed * time$, the Speed of sound on the air is 340 m/s so with the half of the time we can calculate distance , and if the distance is between

-check_opposite: this function , with two arg : id (which captor) and dir (to identify the direction ,it’s the value returned by « checksensor » function) : « take » actual time with « millis() » and go into a while loop which duration is MAX-DELAY (600ms to better identify people) , is this loop there is a condition which check the direction and if the direction is « in » (0) , this incremente people_in value (with pointer), and if the direction is out (1) this incremente people_out value and we left the loop with « break » instruction.

SD PART

We open Serial Communication Port, we check if the sd card is present and ready-to-use and we convert the data value to csv format and we write this on the data file « data.csv" which is on the root of the SD card .
We write the data every 10min (SD_next)

WEATHER PART

We use the sparkfun libraries, and their function to take data from sensor to get the humidity, the light level, and we use pointers (*temp,*hum,*light_lvl) to make it easy-to-save on the sd_card, we keep data every 10min

MAIN

In the main, we use a condition and we call checksensor and checkopposite to increment the right value (*in or *out), and we call SD and weather part function every 10min to save the data on data.csv file in the SD card.

CONCLUSION

This project helps me to learn better Arduino basic and how to manage library in Arduino, and
Several difficulties came to the project, such as the presence of a multitude of defective equipment: an SD bee and two SD card from sensebox did not work, as well as some ultrasonic sensors.

If I had more time, I could do experiment more and obtain some result to try to observe the behaviour of the people entering or leaving the lab, and I should obtain a correlation which reflect this behaviour.
I would aslo make a plastic box to fix better the Arduino system on the wall and do a WIFI part to upload the measure directly on the internet.

REFERENCES

http://www.scitepress.org/Papers/2016/59546/59546.pdf
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3867318/