AN ANALYSIS OF PRESSURE, TEMPERATURE AND HUMIDITY IN A ROOM USING A RASPBERRY PI/ARDUINO UNO / ARDUINO UNO AND BME280

Oluwatobi Toheeb Olajire
X13111434

x13111434@student.ncirl.ie

BSc (Hons) in Computing

Data analytics

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Introduction

1.1 Purpose

The principal objective of this project is to gather information on weather condition in a room and then analyze this information to solve the problems of dampness, which remains one of the key challenges facing houses or apartments in various parts of the world. The project intends to develop an embedded system that helps to control the temperature in buildings. An accurate prediction of the temperatures at which humidity and pressure are in a perfect equilibrium. Since ventilation, room temperature, and humidity are the principal components of the environmental conditions in a room, an adequate control of these factors is expected to ensure that the issue of dampness is overcome by the buildings in which the system will be implemented. Thus, this document presents the specification requirements for the project, which highlight the ways in which it is expected to meet the intended objectives.

1.2 Project Scope

Even though this project intends to solve a very complex societal problem, it has a very simple scope that consists of three main phases. The first phase of the project involves the gathering of information about the temperatures, pressure and humidity fluctuations in a room. The phase involves using the Raspberry pi/Arduino uno to read and record the temperature, pressure, and humidity fluctuations in a room. The second phase employs the data collected from the first phase to conduct a study and determine the best temperatures at which dampness can be avoided in buildings. The final phase of the project displays the output from the phases above on a website. Ventilation has been suggested as one of the

strategies through which this stage of the project can be implemented. Based on the results of the data analytics phase of the project, the ventilations of buildings and other determinants of overall humidity will be adjusted to ensure that such buildings are characterized by the most favorable equilibrium among these factors. Overall, the project implements its principal systems in three phases; the first two phases involves the gathering of data and using it to model the most appropriate setup for an ideal building, while the final phase uses this information to solve the problem of dampness in buildings.

1.3 Definitions, Acronyms, and Abbreviations

For a smoother design and implementation of the main components of this project, certain conventions have been established for the project implementers. Such conventions are intended to unify communication among the stakeholders involved and to make the project less time consuming. The main conventions that are used in the project are in accordance with the following table.

Table 1: Document Conventions

BME280	Sensor - Temp&Humi&Pressure Sensor
DDB	Distributed Database
DB	Database
ER	Entity Relationship
R	Ross and Robert
EDA	Exploratory Data Analysis
ICA	*Independent Component Analysis*
SLM	simple linear regression model
ANN	artificial neural network (ANN) model

GUI	Graphic user interface

2 User Requirements Definition

As highlighted in the above section, this project provides a data-based supervision of temperatures, humidifies, and overall ventilation in buildings. The data obtained is then used to predict the most appropriate environmental conditions that can help to avoid dampness. Therefore, the outcomes of the project are considered as useful assets for application in many contexts in real life. Conventionally, dampness is renowned for encouraging the breeding of mosquitoes, which make houses uninhabitable for people who are vulnerable to malarial infections. The project will lead to the establishment of buildings that are considered to be favorable for children, pregnant women, and other individuals who are at risk of infection by malaria. Thus, hospitals, nursing homes, and residential areas are some of the principal target audiences for the project.

Another principal target audience or user for the project comes in the form of construction experts. Excess moisture in buildings has always been associated with numerous problems. The first challenge that comes with dampness is that it forces moisture to travel through walls, leading to the softening and crumbling of lime plaster. It also causes serious destruction of decorations and paintings on walls. This impact may be of significant financial consequences, especially in

cases where walls have been installed with expensive decorations or paintings. When excess moisture infiltrates into the walls of houses, they cause efflorescence and cause the construction materials like tiles, stones, and bricks to disintegrate. Some of the immediate impacts of such phenomenon include the loosening of floors, walls, and rooves because of the lost adhesion caused by the concentration of moisture in between the construction materials. Thus, the construction companies and experts are also considered as part of the project's main target audiences.

The final target audience for the project's outcomes comes in the forms of experts who are responsible for installing various forms of fittings in houses. Such fittings consists of metallic, timber, and electrical fittings. Timber fittings like doors, wardrobes, and windows may warp, dry-rot, or buckle when exposed to damping conditions. Metallic fittings are often made of metals, like steel or iron, which are highly vulnerable to corrosion. When exposed to damp conditions, such materials may deteriorate due to the corroding effects of excess moisture. This argument is attributed to the fact that water and air are the main causes of the rusting of metals. On the other hand, electrical fittings may be deteriorated by excess moisture, leading to problems, like irreversible damages or short circuits. Thus, the project offers a practical solution to the challenges facing the installation of wooden, metallic, and electrical fittings in buildings.

Taking into consideration that some of the users may not be capable of using highly technical piece of a software. Bellow the user's requirements are listed;

- To be able to detect the conditions that is suitable to breed damp or cause of poor ventilation in a room.
- To analyze and collect the data that is generated by the sensor.
- To Identify damp growth conditions.
- To be able to visualize the collected data.

3 Requirements Specification

3.1 Functional requirements

Functional requirements refer to a list of hardware, software, and database elements that interact with the components of the system. The principal objective of these requirements is to ensure that there will be a proper and reliable communication between the system's elements and external components. They include the User interfaces, the hardware interfaces, and software interfaces.

Hardware

Hardware resources are inevitable in this project as they facilitate the main physical activities that constitute all stages of the project development. Such resources will be used alongside the software resources to facilitate the collection, analysis, and the application of data in understanding and designing solutions to the problem that the project tries to address. The main hardware resources that will be used in this project are as follows:

- Raspberry pi/Arduino uno, operates alongside the BME280 as a system for collecting information about the temperatures, humidity, and atmospheric pressures of the buildings in which the system is employed.

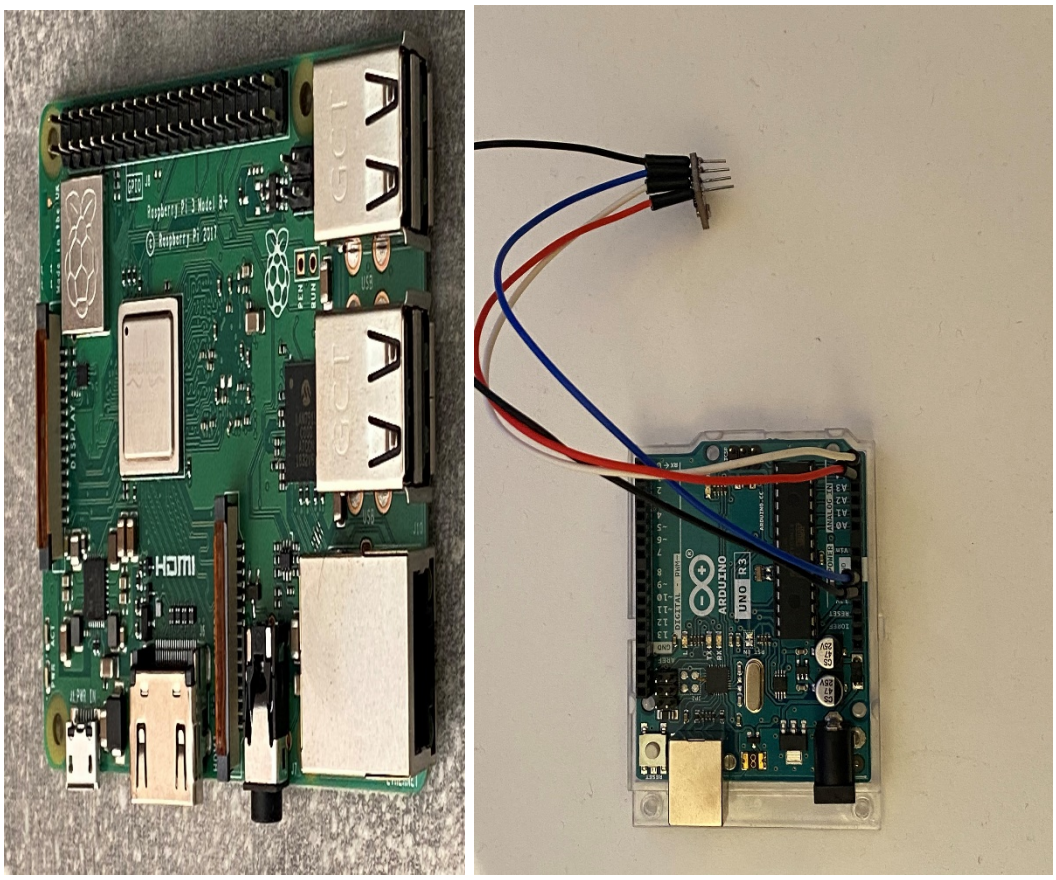


Table: Raspberry pi/Arduino uno

- BME280, which will be used as pressure, temperature, and humidity sensor. It also collects the data about the prevailing environmental conditions within a building and displays so that it can be used for the prediction of the required levels of ventilation to avoid dampness conditions in a room or apartment.

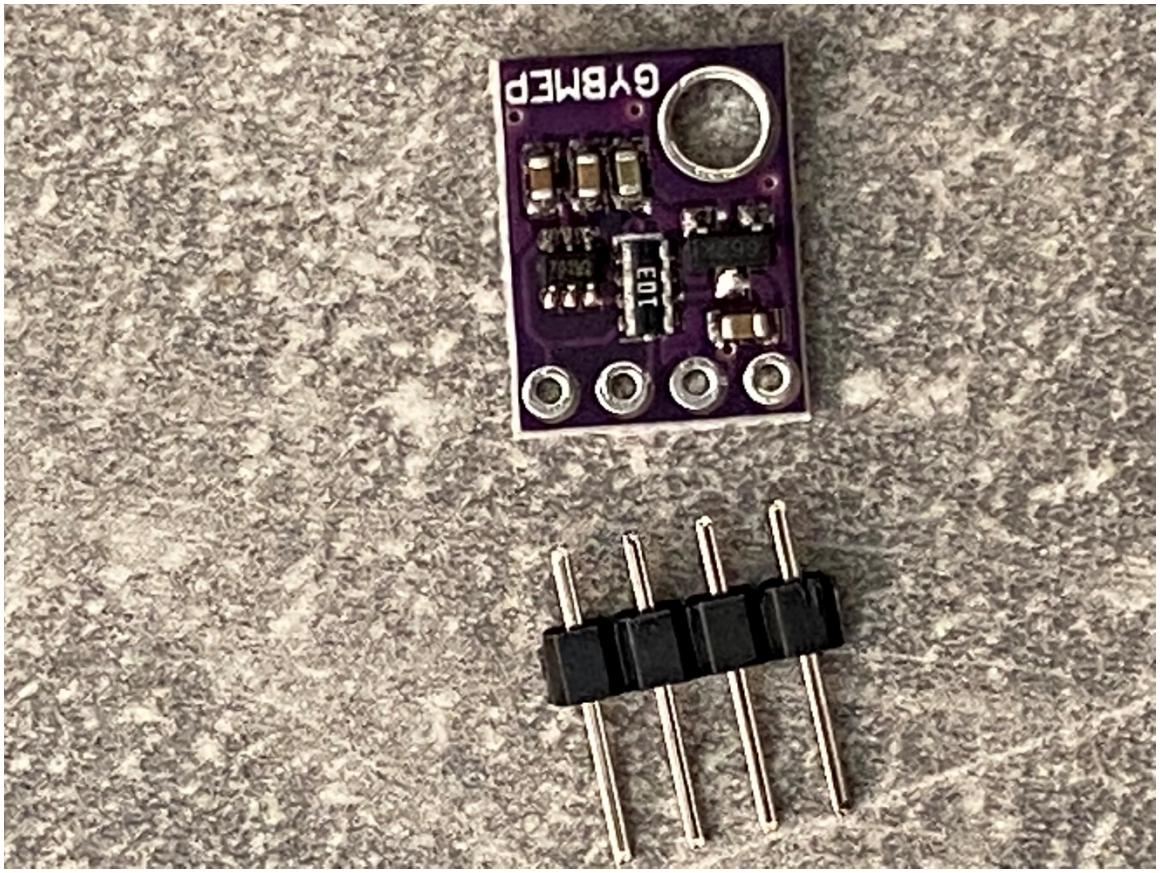


Table: BME280

- A computer to build and test the program codes for errors.
- Arduino uno: it has similar function as the Raspberry pi/Arduino uno, for this project in a situation of technical error or connection error, an Arduino

uno will be used instead of the Raspberry pi.

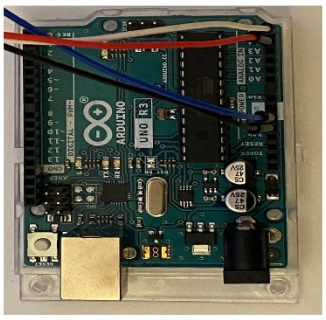


Table: **Arduino uno**.

Hardware Component Used	**Description**	**Function**
Sensor	Raspberry pi	This system is used as another platform on which python programming can be performed. Therefore, this resource is used in association with personal computers for computing purposes.
Sensor	BME280	Used for the purpose of sensing humidity in a room. This device was preferred due to its portability, low current consumption, long-term stability, and high EMC robustness

Macro computing system	Personal Computers	Personal computers will be used to perform tasks like the creation, debugging, and testing of python codes. It is the hardware on which the R studio with python will be installed.
Sensor	Arduino uno	It's a microcontroller board with built in easily accessible package that fastens connection with other sensor.

Table 2: a detail explaining the functional hardware.

Software

Software constitutes another vital aspect of the project. Various software resources will used to perform functions like data analysis, the coding of the website for data vitalization, to store data collected to the database and the coding of the programs to control the actions of the hardware components (see table 3). The software that will be used during the implementation stages of this project are in accordance with the following list.

- R with Rstudio.
- Excel
- PHP
- HTML
- HTML5
- JavaScript

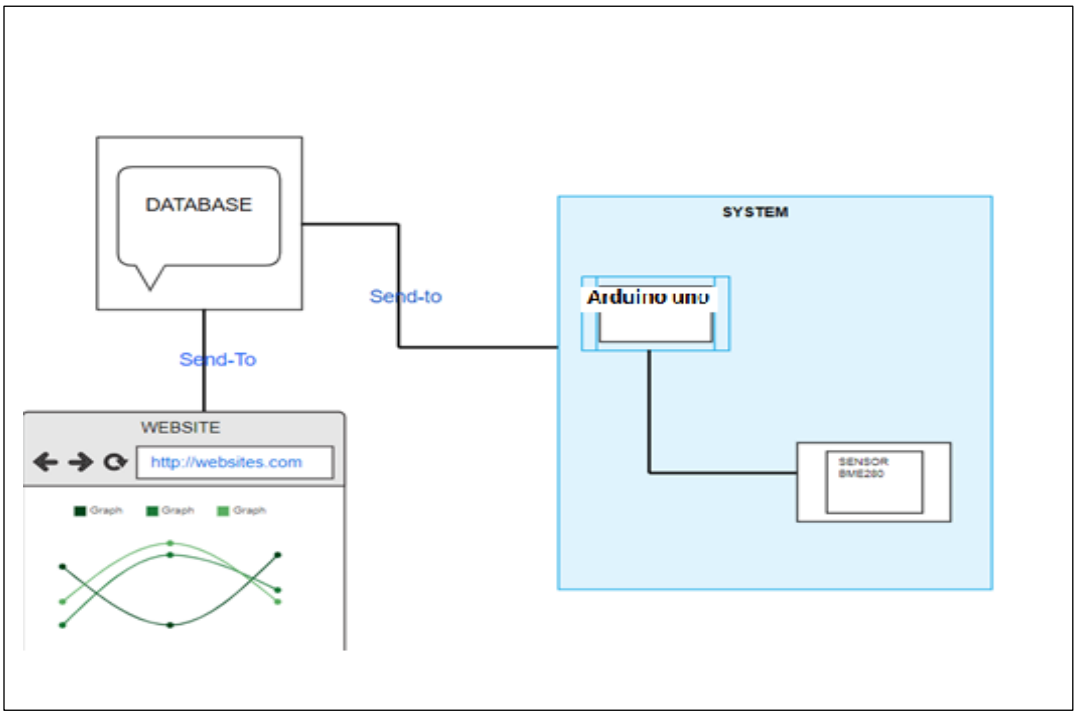
- CSS
- MySQL

Table 3: A detailed description of the project's main software resources

FUNCTIONAL REQUIREMENTS	DESCRIPTION
Sensors	Using sensors to track the environment
Track Humidity over time	Using the hardware sensors, the system will track the humidity levels in a room over time.
Track pressure over time	Using the hardware sensors, the system will track the pressure levels in a room over time.
Track temperature over time	Using the hardware sensors, the system will track the temperature levels in a room over time.
Transfer the data to a Database	The data will be stored on MySQL for visualization on the website.
Prediction models	artificial neural network (ANN) model, and simple linear regression model.
Display the data on a website	All data displayed on the website in a graph.

3.1.1 Use Case

Table 4: Use case Diagram



The bellow table (Table 5) shows the requirements and the identification task they have been given.

Table 5: Requirement task identification.

Use case ID	Use case Name	Complexity	Priority
RQ 1	Hardware sensors for reading the Environment	low	1

RQ 2	Recording Humidity	low	2
RQ 3	Recording pressure	low	3
RQ 4	Recording temperature	High	4
RQ 5	Database	Medium	5
RQ 6	Models	High	6
RQ 7	website	Medium	7

3.1.2 Requirement 1: Hardware sensors for reading the environment

Description & Priority

The Raspberry pi/Arduino uno and BME280 sensor are part of the system, on successful connection of the Raspberry pi/Arduino uno and BME280, they record the environmental condition of temperature, pressure and humidity. They are both hardware devices that is added to the system in order to facilitate the system to record these conditions. The Raspberry pi/Arduino uno is unable to record these environmental conditions without a sensor (BME280), Raspberry pi/Arduino uno collect and transform the recorded data from the sensor into usable data for analysis. This section of the project is very necessary to successfully deliver this project and it is considered the highest priority to the project.

Use Case

The use case for the sensor will be represented as RQ1, simply because without the sensor the system will not be able to record the environmental conditions required. RQ1 will be the sensor that collect the environmental conditions required.

Scope

The scope of RQ1 is to collect the environment condition for temperature, humidity, and pressure, and transfer the collected reading to the Raspberry pi/Arduino uno/ Arduino uno, so that the Raspberry pi/Arduino uno can transfer the data to the database see (Table 4) and record over time, environmental conditions required for dampness prediction.

Description

This use case, RQ1, describes how the Raspberry pi/Arduino uno and the BME280 sensor communicate with each other.

Flow Description

Precondition

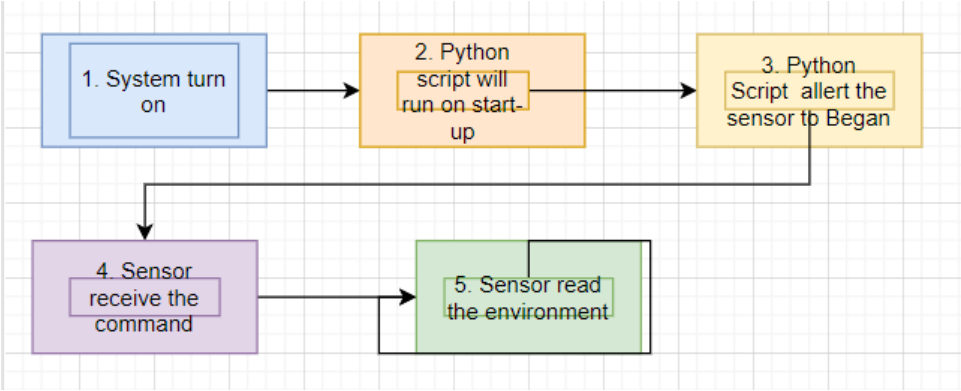
The Raspberry pi/Arduino uno gives the sensor, RQ1, the command to record the environmental conditions required. This section is key to the system and depends on a customized software to monitor logically over time and reliable hardware.

Activation

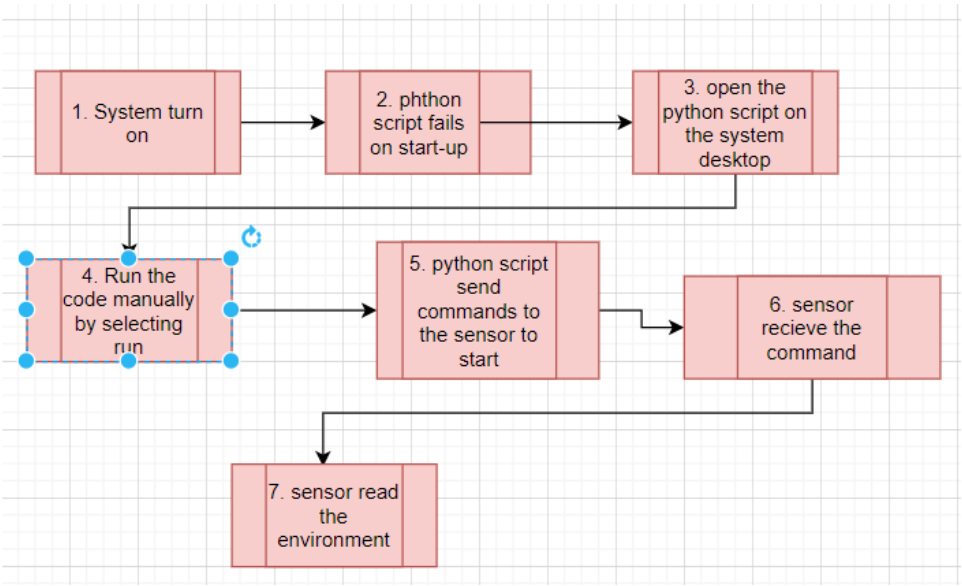
This use case began when the Python script has been run on the Raspberry pi/Arduino uno or when the Arduino uno BME280 script is started on the computer.

This script enables the sensor to detect the environmental conditions required and record and transfer the data to a Raspberry pi/Arduino uno hard drive. The Raspberry pi/Arduino uno is unable to communicate with the BME280 sensor without the python script, also the Arduino uno is unable to communicate with the BME280 sensor without installing appropriate libraries and running the correct script for the BME280 from the packages available on Arduino IDE.

Main flow



Alternate flow



Termination

As soon as the system and the sensor established a successful connection it will proceed to the next stage.

Post condition

The system goes into a waiting state, in order to wait for the next event. The next event in the requirement is recording humidity.

3.1.3 Requirement 2: Recording humidity

Description & Priority

Recording humidity is an especially important part of the system as it is part of the environmental condition data that will be collected to be able help the users to understand the appropriate ventilation needed in a room for damp reduction or prevention. Humidity is an important factor in damp growth, the research suggests that humidity level and temperature level together allow for growth of damp.

Use Case

The use case for recording humidity will be identified as RQ2, because without the humidity the system is not able to collect the data needed.

Scope

The scope of RQ2 is to collect environmental condition which is the humidity level within a room. As the Raspberry pi/Arduino uno record the data, it stores the data in the database. The database will transfer the data to a website and record over time the humidity level of a room.

Description

This use case describes how the sensor and the environmental condition humidity interact with each other.

Flow Description

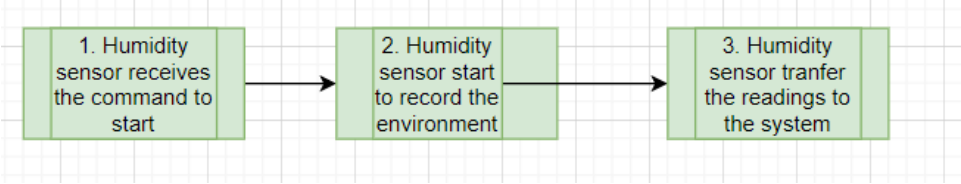
Precondition

The sensor read the environmental condition to determine the humidity and then transfer the data to the Raspberry pi/Arduino uno, which is the Actor.

Activation

This use case began when the sensor has established a successful connection with the Raspberry pi/Arduino uno. The sensor will start to record the environmental condition to detect humidity level in the environment then transfer and record the data on the Raspberry pi/Arduino uno hard drive.

Main flow



Termination

Once the sensor has recorded the environment humidity level and store the readings to the database, it will proceed to the next event.

Post condition

The system goes into a waiting state, in order to wait for the next event. The next event in the requirement is recording Pressure.

3.1.4 Requirement 3: Recording pressure

Description & Priority

Recording pressure is another part of the system that is important, as it is the other piece of data collected which will be used in creating a complete set of data in order to facilitate the cause of damp growth for the system users understanding.

Use Case

The use case for recording pressure will be identified as RQ3, because without the pressure the system is not able to collect the data needed.

Scope

The scope of RQ3 is to collect environmental condition which is the pressure level within a room. As the Raspberry pi/Arduino uno record the data, it stores the data in the database. The database will transfer the data to a website and record over time the pressure level of a room.

Description

This use case describes how the sensor and the environmental condition pressure interact with each other.

Flow Description

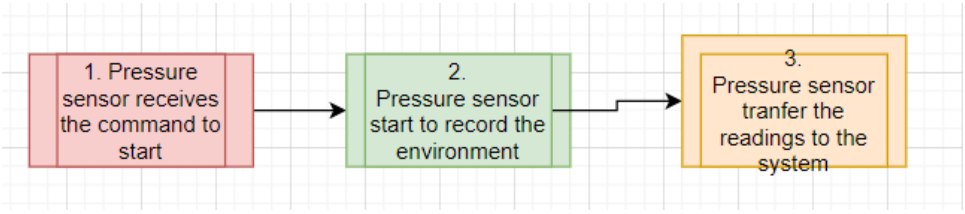
Precondition

The sensor read the environmental condition to determine the pressure and then transfer the data to the Raspberry pi/Arduino uno, which is the Actor.

Activation

This use case began when the sensor has established a successful connection with the Raspberry pi/Arduino uno. The sensor will start to record the environmental condition to detect pressure level in the environment then transfer and record the data on the Raspberry pi/Arduino uno hard drive.

Main flow



Termination

Once the sensor has recorded the environment pressure and store the readings to the database, it will proceed to the next event.

Post condition

The system goes into a waiting state, in order to wait for the next event. The next event in the requirement is recording temperature.

3.1.5 Requirement 4: Recording temperature

Description & Priority

The requirement that the system records the environmental condition for temperature level over time is also a significant part of the system, as it is the other piece of data collected which will be used in creating a complete set of data in order to facilitate the cause of damp growth for the system users understanding. Temperature level is an important factor to damp growth.

Use Case

The use case for recording temperature will be identified as RQ4, because without the temperature the system is not able to collect the data needed.

Scope

The scope of RQ4 is to collect environmental condition which is the temperature level within a room. As the Raspberry pi/Arduino uno record the data, it stores the data in the database. The database will transfer the data to a website and record over time the temperature level of a room.

Description

This use case describes how the sensor and the environmental condition temperature interact with each other.

Flow Description

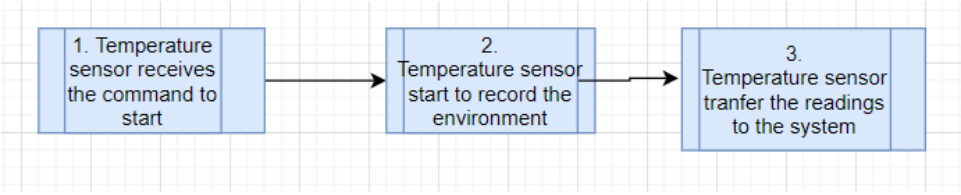
Precondition

The sensor read the environmental condition to determine the temperature and then transfer the data to the Raspberry pi/Arduino uno, which is the Actor.

Activation

This use case began when the sensor has established a successful connection with the Raspberry pi/Arduino uno. The sensor will start to record the environmental condition to detect temperature level in the environment then transfer and record the data on the Raspberry pi/Arduino uno uno hard drive.

Main flow



Termination

Once the sensor has recorded the environment temperature and store the readings to the database, it will proceed to the next event.

Post condition

The system goes into a waiting state, in order to wait for the next event. The next event in the requirement is storing the environmental conditions into a database.

3.1.6 Requirement 5: Database

Description & Priority

The database is a key aspect of the system, in the section, the database is used to store all the data collected from the sections above so that it can be used at any time. This section is an important part of the system process, as the data collected by the Raspberry pi/Arduino uno and the sensor is sent to the database.

Use Case

The use case for the database is identified as RQ5, because without the database the system is not able to store the data needed.

Scope

The scope of this use case is to store the data collected from the environmental conditions. The Raspberry pi/Arduino uno has formatted the data properly after collecting from the sensor. The data collected when transferred to the database will be trained with three different machine learning models and then it is displayed on a website.

Description

This use case describes how the Raspberry pi/Arduino uno and the database interact with each other.

Flow Description

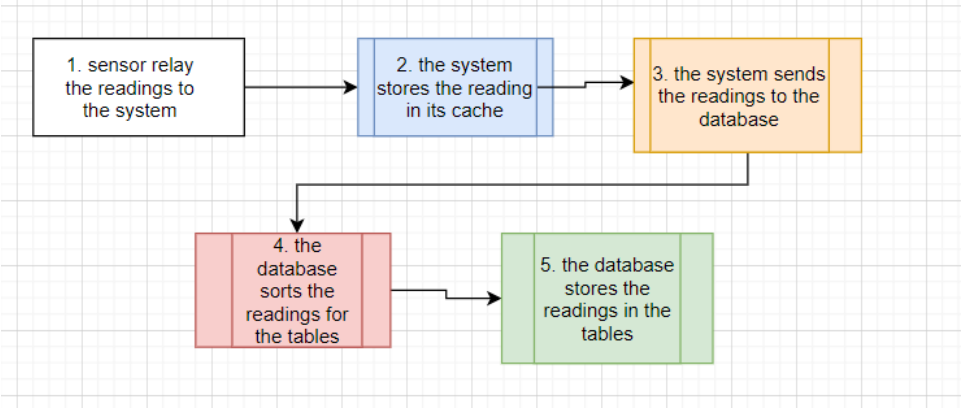
Precondition

Once the Raspberry pi/Arduino uno has the data from the sensor, it will send it to the database to be reviewed.

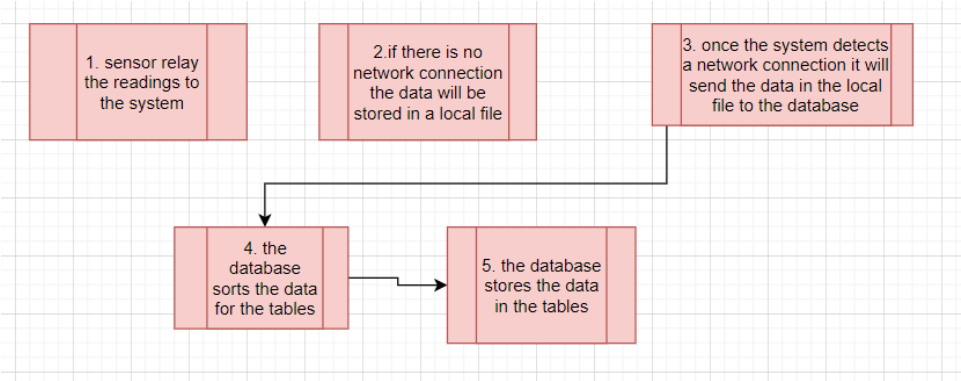
Activation

This use case starts once the Raspberry pi/Arduino uno have collected the environmental condition from the sensor, the Raspberry pi/Arduino uno store it in the database.

Main flow



Alternate flow



Termination

As soon as the database has received and stored the data collected from the environmental conditions, it will proceed to the next stage.

Post condition

The system goes into a waiting state, in order to wait for the next event. The next event in the requirement is running three different machine learning models on the data stored in the database.

3.1.7 Requirement 6: Models

Description & Priority

The machine learning models are key to the system, as it will help the users to understand and make easy assuming or predictions on the appropriate ventilation control for a room to prevent or avoid dampness in a room.

Use Case

The use case for the models is identified as RQ6, because without this model the users will not be able to view the data in a logical and understandable way.

Scope

The scope of this use case, models, is to train the data as to understand and make easy assuming or predictions on the appropriate ventilation control for a room to prevent or avoid dampness in a room.

Description

This use case describes how the models and database interact with each other.

Flow Description

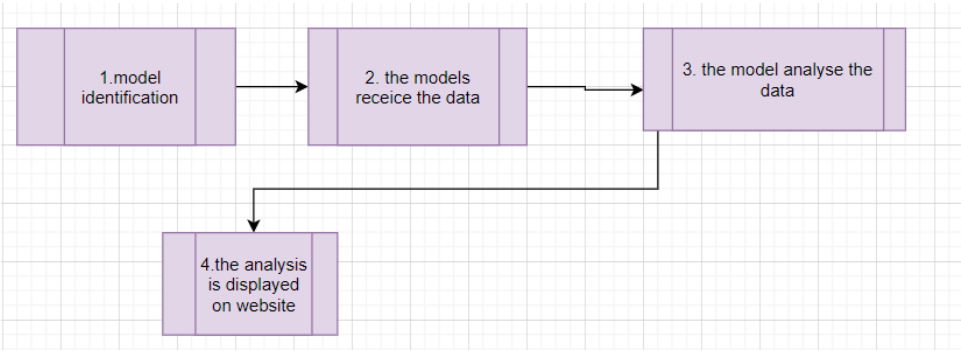
Precondition

Once the data is stored in the database successfully, the data will be pulled from the database will then have it trained with the three different models.

Activation

This use case began once the data is stored successfully to the database.

Main flow



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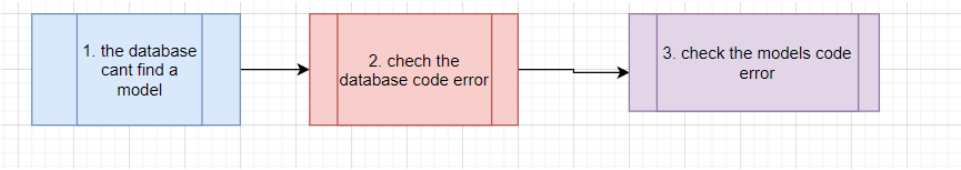


Termination

Once the models have received the data from the database the models will analyse the data and it will proceed to the next section.

Post condition

The system goes into a waiting state, in order to wait for the next event. The next event in the requirement in displaying the analysis on a website.

3.1.8 Requirement 7: Website

Description & Priority

The website is the final section of the system, the website will allow it users to view all analysis gotten from the models and also makes it easy for the users to understand. The website is important as it is the user's GUI for the system.

Use Case

The use case for the website is RQ7, the website gives the system users the opportunity to view the analysed data in a meaningful way.

Scope

The scope of this use case, website, is to allow users view the outcome of the models in a meaningful way to ease the interpretation for ventilation control.

Description

This use case describes how database, models and sensor interact with each other.

Flow Description

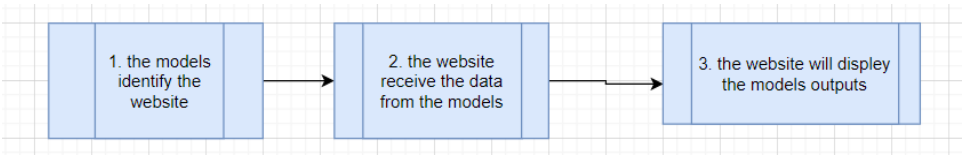
Precondition

Once the data has been trained with the models, they will then be displayed on a website.

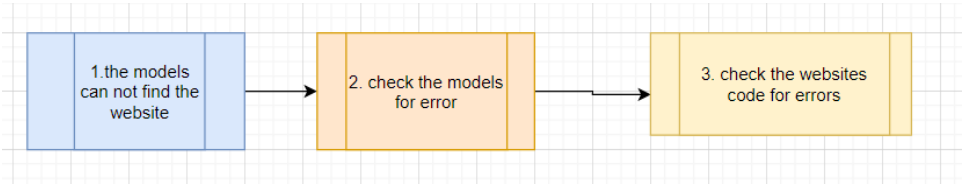
Activation

This use case began once the models received the data from the database. The output is the displayed on a website.

Main flow



Alternate flow



Termination

Once the models have mapped the data from the database, they will be easily accessible on the website. This stage is final for the system.

Post condition

The system will go to a final state in this case of the requirement, to activate the next task. The next task here is to display the information on the website.

3.2 Non-Functional Requirements

3.2.1 Performance/Response time requirement

Performance requirements are necessary to ensure that the project not only meets the desired objectives but also to ensure that it meets these goals with the required levels of efficiency and precision. Therefore, this section of the chapter presents the optimal characteristics that make the system both efficiency and justifiable.

Speed and Convenience: The first factor of performance is speed, which also dictates the convenience of the device and its outputs. Generally, users require systems that produce results within short period of time. This way, it is easy to make quick decisions regarding the courses of actions to taken in order to overcome the encountered problems. In this instance, the users of this project will always count on them to provide quick results for the temperature, humidity, and the atmospheric pressure prevailing in a building or room. When the outputs are produced within a short time, the user can key in the values in the ventilation predictor when prompted to do so such that the results of the final part of the system is obtained more quickly than in the case where the system operates sluggishly. The device's speed enables it to produce the results at each stage of the analysis in an almost instantaneous manner. Therefore, it is considered as

one of the most reliable systems that can be used to quickly analyze data and produce results within a short period, even in the cases of highly complex problems.

A simple Friendly User Interface: Another performance parameter that has been identified in the previous sections of this discussion is that the system comes with a very friendly and simple user interface. The communication between the user and an embedded system is considered as one of the quality determinants of the performances of such a system. Therefore, systems with easier and more direct interfaces are considered to be more efficient than the ones with more complex interfaces. As highlighted in the previous sections of this discussion, the system presents both textual and visual forms of communication with users. The textual communication occurs when the user is requested to key in the values of a room's environmental conditions as measured by Raspberry pi/Arduino uno/Arduino uno. On the other hand, visual communication occurs in the form of the results obtained from the various forms of data analysis performed by the system. Therefore, this device is considered to be efficient in terms of the nature of interface that occurs between its functional components and users.

3.2.2 Safety requirement

Safety is a mandatory requirement for any system, regardless of the purpose for which it is designed. Systems that use electrical and electronic components are prone to accidents that can cause injuries or even death to the users. The concept of safety also includes the measures against the events that can potential damage the system itself. Therefore, it is imperative that a system is besieged with features

that makes it safe for both its components and the user. The main components of this device are the Raspberry pi/Arduino uno and the BME280, which are low power consumers and can be operated using batteries. This property is of significant benefit to both the system and users. When systems can easily be operated using low-power batteries, there is never any need to connect them to powerful power supplies. Consequently, such systems are propertied from unexpected power surges that can cause short circuits or complete destruction of their components. Additionally, the user is never at any risk of being involved in fatal accidents, like electrocution. Therefore, this project results in the development of a product that is considered safe for users and is less prone to damages that may result from power failures or short circuit connections.

3.2.3 Operational Efficiency requirement

Efficiency is an inevitable requirement for any system that uses electronic systems that are driven by computer codes. Another rationale behind the need for efficiency is that this system is intended to solve real-life problems. Therefore, its utility can only be justified if it offers adequate efficiency. The concept of efficiency can be attributed to both the simplicity and the sensitivity of the measurement equipment used. The Raspberry pi/Arduino uno provides a platform on which python programming can be performed while in case of the Arduino uno, it provides its own coding environment with built in libraries to facilitate easy connections. The creation of the codes is a critical part of this project since it ensures that a practical code for controlling the actions of the BME280 is developed. The personal computer is used to test the resulting pseudocode to ensure that it is free of any errors. The detailed testing of codes contributes to additional efficiency of the project, as it ensures that all the functional units of the system are in their perfect working conditions. The BME280 system, which is used as part of the system is a sensitive humidity sensor that is capable of detecting amount of water vapor in a given environment with high accuracy levels. This component also makes the device more efficient in the measuring of humidity through the introduction of additional accuracy. Additionally, actual data is used to generate a relationship between ventilation and the stated environmental conditions. This property ensures that the system operates on the basis of empirical rather than theoretical principals. The outcomes that are obtained from the manipulation of actual data are considered to be more accurate, as they are free of vague assumptions. The final feature that boosts the system’s efficiency is the fact that it uses a few variables. Systems that use a wide variety of variables are always prone to errors since the overall error associated with them are the sum total of the individual errors that characterize each of the variables. The same applies to the number of components that constitute the entire system. The main elements that can be subjected to errors are the BME280 and the Raspberry pi/Arduino uno. Since only two components can be subjected to any forms of error, the system is considered to be safe from the destructive errors that are internal to each of the constituent

elements. Overall, this project offers a high level of efficiency due to the fact that it uses a few variables, a simple data analysis system, and a few variables, which make it less prone to errors.

3.2.4 Security requirement

Conventionally, any system that uses data and computer systems to operate is always subjected to cyber threats. Cyberattack can be implemented in ways, depending on the attacker's intentions. Certain attackers prefer to steal valuable information, an act that compromises the integrity and the confidentiality of data used in a given system. On the other hand, certain cybercriminals prefer to use techniques such as denial of service (DoS) and SQL injection, which are intended to interfere with the functional characteristics of the system (Muka 2018). Therefore, systems that are characterized by data traffic are always highly vulnerable to the damaging impacts of cyberattack. This project leads to the creation of a device that collects its own data and processes it almost instantly. The information that is subjected to analysis by the system does not pass through third parties (Muka 2018). In essence, the system is free of any forms of data traffic between two geographically isolated locations. Therefore, the system is not vulnerable to any forms of cyberattack. However, intentional or unintentional attempts to feed the system with wrong data can lead to a general compromise in its operational efficiency. Overall, the system's security can be enhanced by ensuring that the information that is fed into the processor is strictly obtained from the displays provided by the humidity sensor and the instruments used to measure other variables.

3.2.5 Software Quality requirement

The software components of this system are charged with the responsibilities of controlling the actions of the hardware to ensure that accurate measurements are taken. The software components also initiate the selective measurement of different parameters to ensure that adequate information is availed for subsequent analyses. The most important software quality attributes for this system are availability, correctness, usability, and maintainability. The system should be available and in operational order when it is required to take measurements and to perform various types of analysis on the collected data. Availability is important because the utility of the project can only be experienced when it is accessible to the target user. Correctness is another critical quality attribute for the system, especially considering that the instrument deals with the measurement of natural phenomena. The validity of the outputs of this system depends on the accuracy with which measurements are taken. Accurate measurements can be used to model accurate relationships among the associated variables. Such a model can then be generalized and employed in other contexts to give reliable findings. Therefore, the system is required to be as accurate as possible, especially when measuring the core variables, like humidity, temperature, and air pressure. When

these measurements are correct, the generated code will be able to create a practical model relating humidity and ventilation such that the former can be effectively controlled by regulating the latter. Maintainability is maintainability refers to the ability of the system and its core components to remain in correct operational status over a period of time even when used in different locations. Since the device is to be used to measure humidity and suggest the most appropriate ventilation in different locations, it is essential that it remains operations over a long period of time. This way, its economic value will be experienced as it will be able to serve more than just a single context. Usability refers to the ease with which the devise can be used. This property is determined by the nature of the user interface that characterizes the product. Measuring the humidity of a room, an apartment, or an entire building is a task that should be performed by anyone regardless of their skill or literacy levels. Therefore, the device that is designed to perform this function should be easily usable to the user. Any person should be able to understand the system and its overall application. This device has been designed with a simple user interface, which makes it highly usable to most people, if they are conversant with both textual and visual communication.

4 Interface requirements

A successful connection between the Raspberry pi/Arduino uno and the sensor is important for the system to run, however, for a successful connection, the Raspberry pi/Arduino uno require an interface to be enable before it will be able to communicate with the sensor. This interface is called I2C interface.I2C it is located on the Raspberry pi/Arduino uno. This interface is supported by Raspberry pi/Arduino uno on its GPIO header (Matt Hawkins 2019). And it is a great way of connecting sensors to the Raspberry pi/Arduino uno. Likewise, for the Arduino uno, it only required the installation of the necessary library for the project on the Arduino IDE and proper formatting of the code test example already available on the Arduino IDE.

4.1 GUI

Graphic user interface (GUI) is the frontend part of the project where the users can view the information in deferent models of analysis. For this project the GUI is a website that will display the trained models' outcome on different pages to help users easily interpret the analysis, each of the three model's analysis are displayed on different pages.

The seven pages on the website are listed below.

- Home page

- Registration page
- Login page
- (NARX) algorithm Model page
- artificial neural network (ANN) model page
- simple linear regression model page
- Contact us page

The data collected will be trained with three different models which the outcome will be displayed on these pages. The data will be pulled from the database using SQL, HTML5, CSS, Json, and JavaScript.

The pages listed above will be linked using navigation bar with six buttons that when clicked it displays the right information and page.

Home Page

The home page is the first page of the website and it is the welcome page to all users. On the home page there will be six buttons in a navigation bar, with links behind them that link the buttons to the appropriate page when clicked. A simple mock-up version of the home page can be seen below.

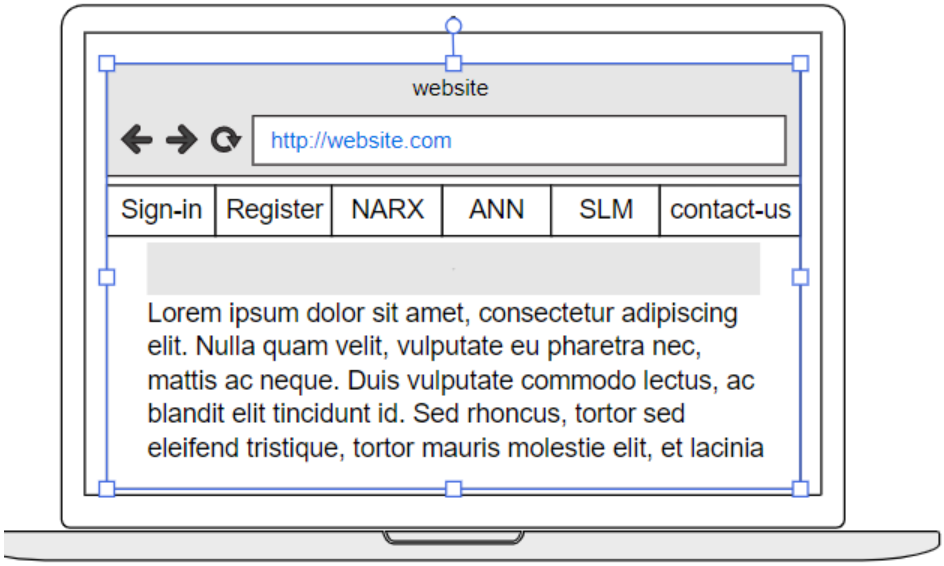


Table: Home page.

Registration page

The registration page will have six buttons in a navigation bar, with links behind them that link the buttons to the appropriate page when clicked. This page is where the users input their information to create an account on the website, see below. This information will then be stored in the database.

Table: Register page.

Login page

The login page is like the registration page above, the only difference is when the user clicks the sign-in button a pop-up menu displaying the user email and password input field form see below. It the check if the input is available on the database and then welcome the user in on successful login.

Table: Login page.

ANN model page

The ANN page will have six buttons in the navigation bar so as to allow users to navigate the website without having to return to the home page. This page displays the analysis output from the trained model with the ANN model. This page can only be accessed with a login details or an account.

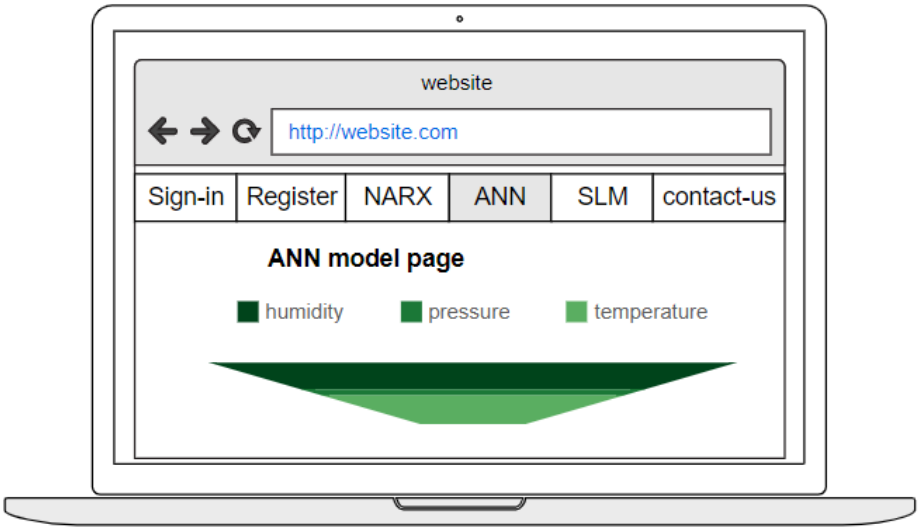


Table: ANN model page.

SLR model page

The SLR page will have six buttons in the navigation bar so as to allow users to navigate the website without having to return to the home page. This page displays the analysis output from the trained model with the SLR model. This page can only be accessed with a login details or an account.

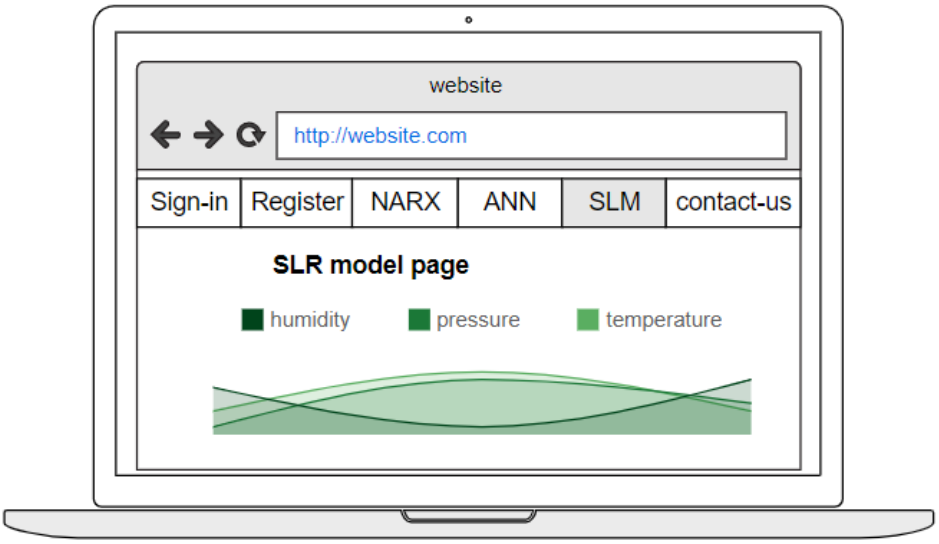


Table: SLR model page.

Contact us page

The contact page will have six buttons in the navigation bar so as to allow users to navigate the website without having to return to the home page. This page will allow users to send administrator an enquiry.

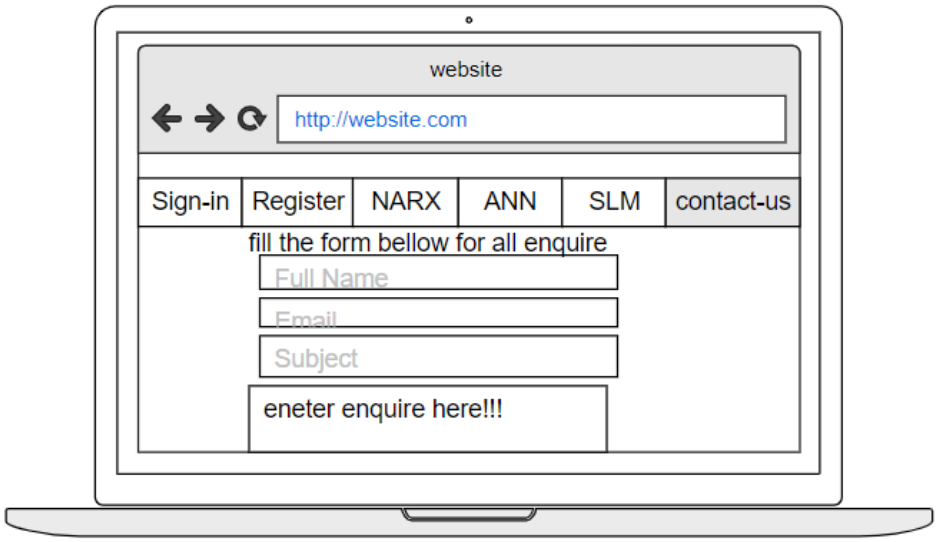


Table: Contact page.

5 System Architecture

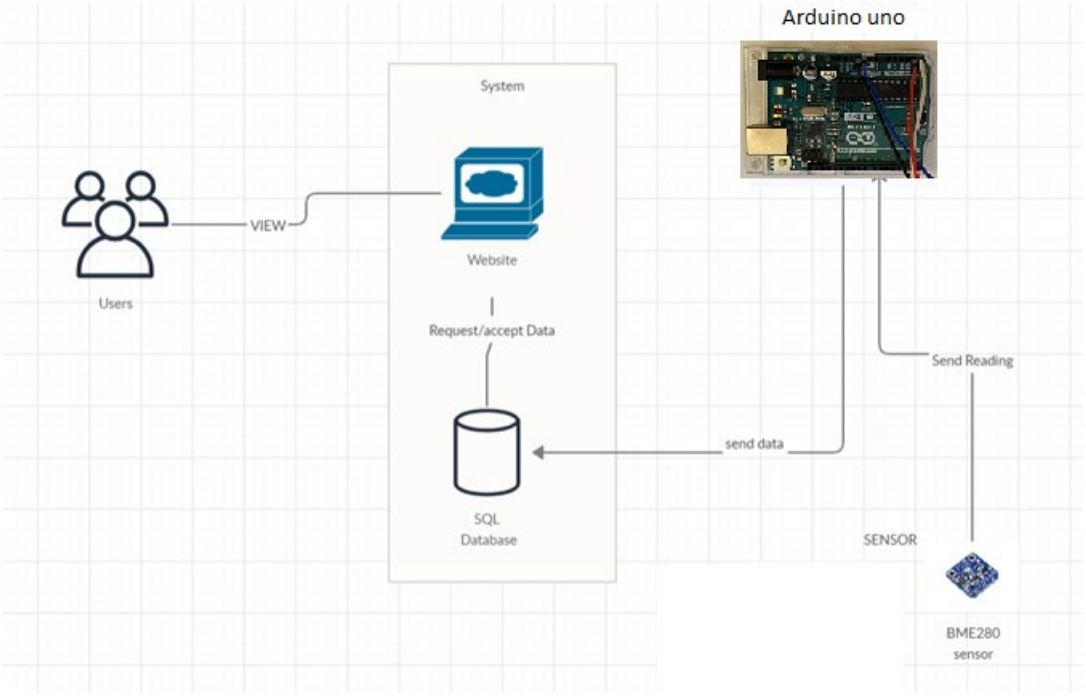


Table: System Architecture

5.1 Hardware setup:

Step 1:

The first step is to collect the hardware components required see the table below, which are as follow, USB SD card 8GB or larger, non-solder breadboard, BME280, soldering tools, Raspberry pi/Arduino uno and female to female jumper wires.

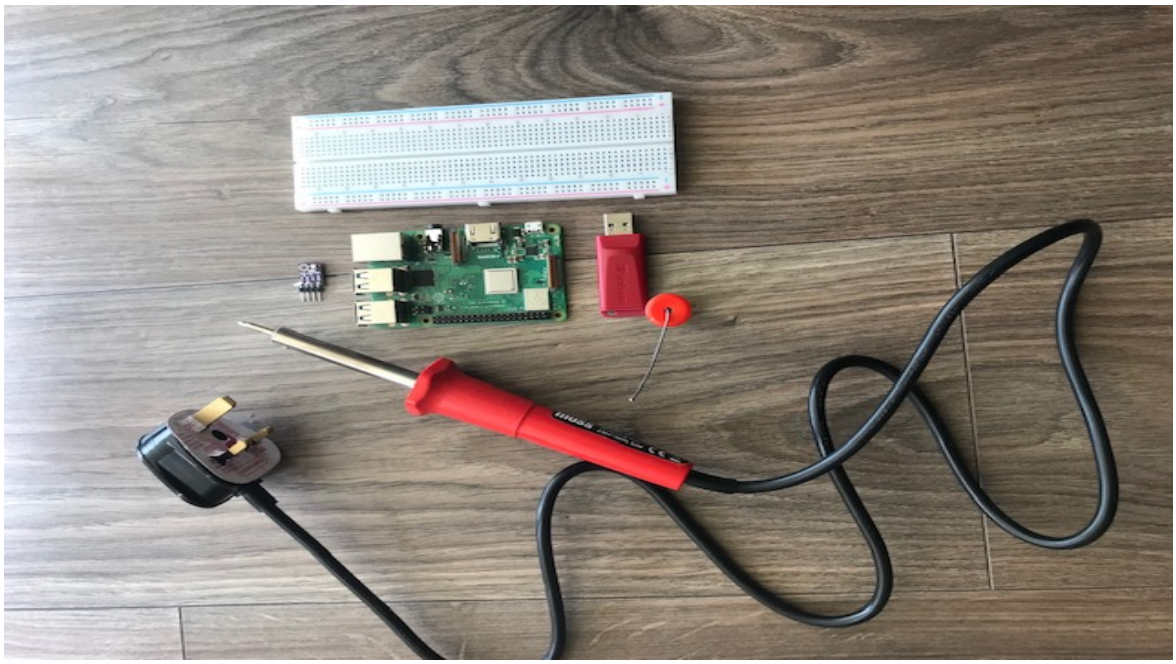


Figure:

Step 2:

This step involves soldering the BME280 sensor ready for use, see below.

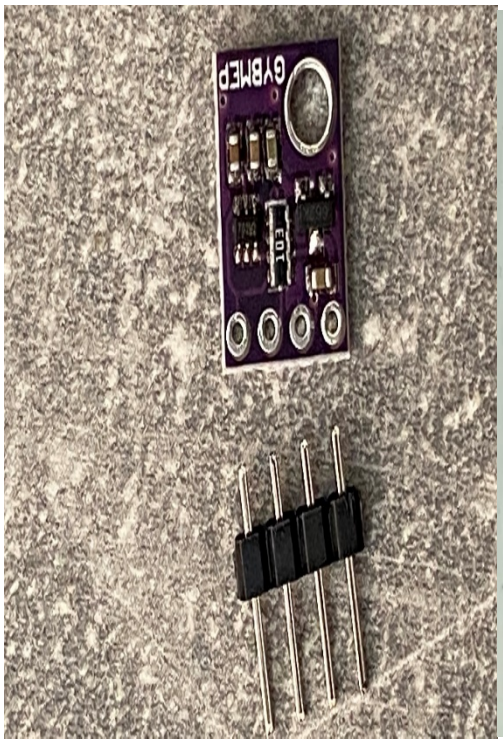
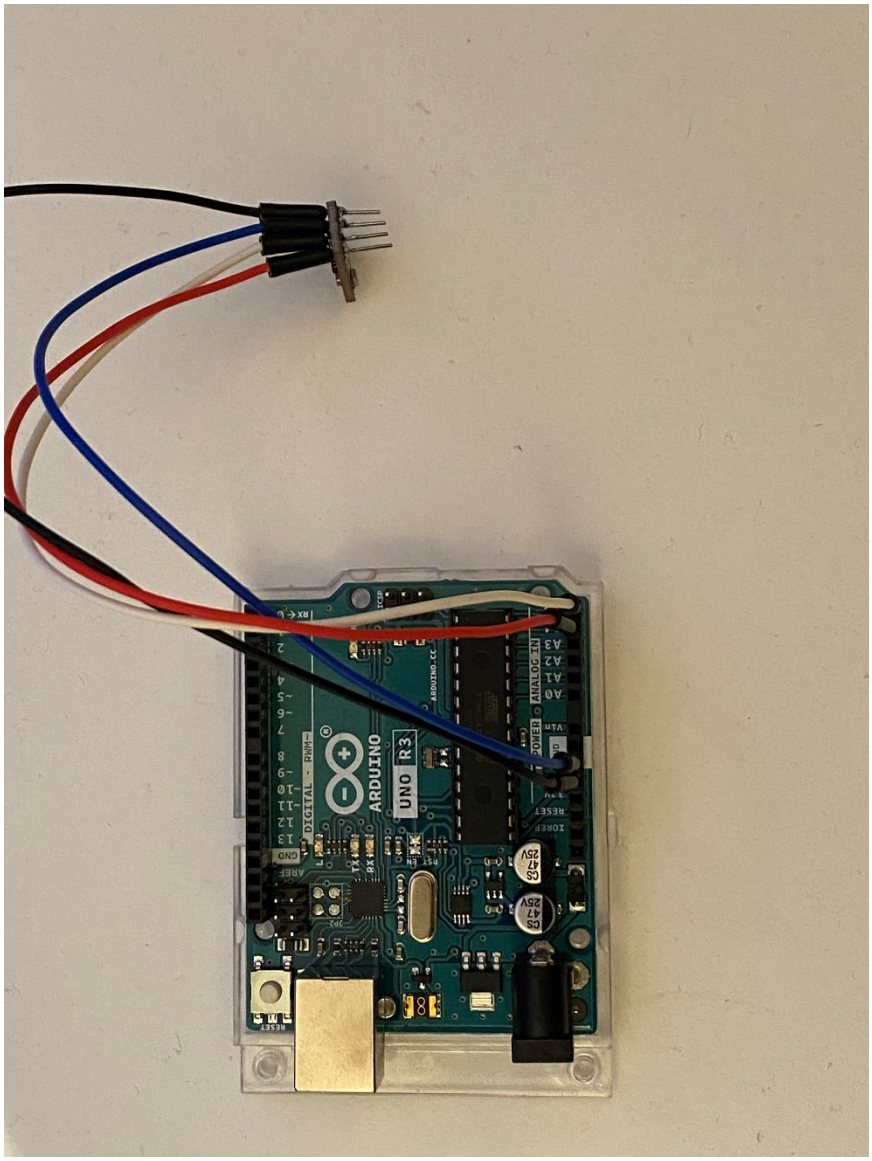


Table:

Step 3:

Connecting the Arduino uno to the BME280



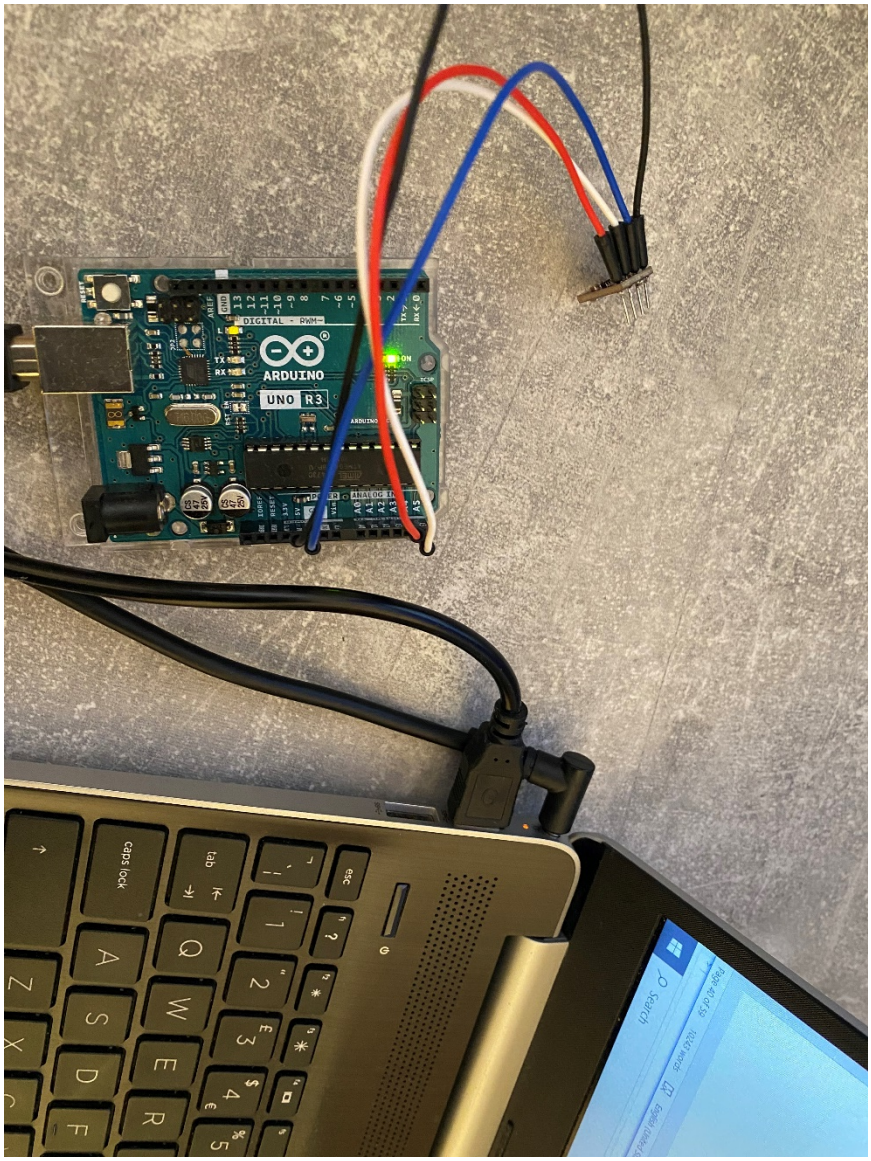
Arduino uno and BME280

Arduino UNO port	BME280 port
5V	VIN
GND	GND
A5	SCL

A4	SDA

Step 4:

Linking the Arduino uno and BME280 to the computer for testing and data generation.



Arduino uno and BME280 connected to a computer.

5.2 Software setup:

Step 1.0: Raspberry pi

install python on Raspberry pi

Python 2 and Python 3 come pre-installed on Raspbian operating systems, but to install Python on another Linux OS or to update it, simply run one of these commands at the command prompt

```
sudo apt-get install python3
```

Step 1.1: Download BME280 Script

To download the BME280 Python script from a Bitbucket repository you can use :

```
wget -O bme280.py http://bit.ly/bme280py
```

Step 1.2:

Run the Script

Before running the script, you should check that your device is connected. If you installed the i2c-tools package as part of the i2c setup you should use the i2cdetect command to check it returns an address for your device. The script assumes the address is 0x76. You can change that by editing the DEVICE variable in bme280.py using your favorite text editor.

Run the script using:

```
python bme280.py
```

(make sure you are in the correct path of the script)

Step 2.0: Arduino uno

Download and Install Arduino IDE on the computer.

Step 2.1:

Connect Arduino uno and BME280 to the computer.

Step 2.2:

Install required packages for the BME280 depending on the BME280 used, in my case I installed the Adapt fruit BME280 library for the project to run successfully.

Step 2.3:

From the file menu on Arduino IDE, run an example of the library installed to test run the BME280.

Step 2.4:

Leave code to run over 24 hours period to generate data required for project.

6 Project Proposal

6.1 Proposal Introduction

The climatic conditions of houses can be defined by many factors, such as humidity, temperature, and atmospheric pressure. Generally, water, heat, and air are renowned for their ability to react with other compounds and the physical impact that they have on materials. Therefore, weather conditions, like humidity, air pressure, and temperature always affect the materials with which they come into contact. One of the contexts in which these factors are considered to be highly impactful is the case of the conditions of houses or apartments. The amount of water vapor in an enclosed space like a room affects the surrounding systems like construction materials and other susceptible items that may be stored in such locations. Even though humidity is an important component of the atmosphere, excess quantities of water in the atmosphere can be of negative impact on buildings and the items that are installed in them. The condition where there is excess water vapor in the atmosphere at a given location is referred to as dampness. The effects of water vapor on buildings, construction materials, and domestic utilities depends on the amount that is contained in such environments. Therefore, it is essential to conduct critical studies on the challenges that come with extreme humidity and how these problems can be eradicated.

6.2 Objectives

As highlighted above, the availability of excess water vapor in the atmosphere can be destructive to buildings and other structures that are susceptible to the destructive impacts of this substance. Conventionally, ventilation is always regarded as the main approach to controlling the humidity within a house or any other enclosed space. This function is based on the phenomenon that allowing more air into a building has the capacity to expel highly humid air and replace it with relatively dry air. The main problem that make it difficult to control the humidity of a building, a house, or an apartment is that it is difficult to relate ventilation and humidity in such a way that accurate modifications can be made to ensure that the two exhibit a perfect equilibrium. Measuring the environmental conditions is too difficult, while the results of such measurements are not of immediate importance to users who intend to control the humidity of buildings. The main objectives of this project are as follows:

- To use sensor to measure the overall temperatures, humidity, and air pressure in apartments using the Raspberry pi/Arduino uno/Arduino uno and BME280
- To use the prediction model to determine how temperatures, humidity, and air pressures in buildings, correlate with ventilation levels.
- To create a algorithmic model that describes the above relationship To use the developed model to advice on the required ventilation levels of buildings based on the measured temperatures, air pressures, and humidity of houses or apartments.

6.3 Background

When I was researching for my final year project, I was not sure what I was going to do, so I had to check the college project list. The study questions for this study are derived from its principal objectives. Even though the project is a problem-solving endeavor, it aims to provide answers to some of the questions that are

considered to puzzling in the modern society. The main questions that the project intends to answer are as presented in the list below.

- How can Raspberry pi/Arduino uno and BME280 be used to measure the overall temperatures, humidity, and air pressure in apartments?
- What are some of the ways of determining how temperatures, humidity, and air pressures in buildings, correlate with ventilation levels using the predictor model?
- How do temperatures, humidity, and air pressures in buildings, correlate with ventilation levels in buildings?
- How can the relationship between environmental conditions and ventilation be used to advice on the required ventilation levels of buildings based on the measured temperatures, air pressures, and humidity of houses or apartments?

6.4 Technical Approach

The technical approach mainly highlights the methods, techniques, and skills that will be used to ensure that the principal objectives of the project are met with the required levels of efficiency and precision. It also highlights the main resources that will be required to ensure that the core goals of the project are met successfully. The technical approach for this project consists of research, application design, prototyping, and evaluation.

Development

For the development of my project, I will be using R & python, I can connect to the Daft API through a python proxy API on GitHub and use that to pull down all of the listings on Daft.ie. From there I can organize that data into a data frame in R and run a data analysis on it with my data model. I will probably also be using MySQL for a database, and Excel or Tableau for data visualization.

Literature Review

Research constitutes the first stage of the operational phases of the project. In order to come up with the required deliverables, it is important to develop an exhaustive understanding of the concept and all the skills that will be needed to complete the constituent tasks. Some of the areas that require adequate understanding include the structures and functions of both the BME280 and the Raspberry pi/Arduino uno. This stage of the development will involve the extraction of useful information about the technical aspects of project and the resources that are required to successfully implement them. Another practice that will constitute this stage is the detailed review of the python programming language and how it can be used to develop a reliable model describing the relationship between ventilation and environmental factors, like humidity, temperature, and air pressure. Overall, this phase of the project will involve consulting existing literature, case studies, and similar projects to develop a deeper understanding of the project and the associated auxiliary tasks.

As highlighted in the above section, this project will consist of three main functional units. Each of these units will contain a specific set of information and will perform a specific set of functions. Likewise, the resulting product will contain three pieces of information that are considered to be vital in the determination and the control of environmental conditions within buildings. Such information includes the following.

Humidity. This parameter comes in the form of the overall amount of water vapor that characterizes the air circulating within a building or a room. This information also acts as an indicator of the likelihood of precipitation, fog, or due to occur within the neighboring environment (Lane, Ames Research Center, & United States 2014). The humidity aspect of the instrument will be expressed as the total number of grams of water vapor in every cubic meter of the room under consideration at room temperature. The parameter will also be expressed in terms of its absolute, specific, and relative values. The absolute value of humidity is the mass (in grams) of water vapor in every cubic meter of space within a room (Lane, Ames Research Center, & United States 2014). The specific value will be expressed as the ratio between the mass of water vapor in a room and the total moisture in that room. On the other hand, relative humidity will be expressed as the percentage of the humidity in a room relative to the minimum possible humidity at a given temperature.

Temperature. The temperature of a room is another important piece of information that will be communicated by the instrument. The parameter will give an

expression of the overall hotness of coldness of coldness of a room or a building in general (Lane, Ames Research Center, & United States 2014). The Kelvin scale will be used since it is more appropriate for use in scientific contexts (Lane, Ames Research Center, & United States 2014). Overall, the part of the instrument that deals with temperature will record and display the general room temperature of a room or a building at a given instance.

Pressure. Atmospheric pressure is another important piece of information that will constitute the instrumentational aspects of the project. Even though atmospheric pressure results from the gravitational attraction between the earth and the planet's atmospheric gases, it is also affected by the amount, composition, and overall distribution of the atmospheric gases. Therefore, humidity, which is one of the core components of the atmosphere, is regarded as one of the factors affecting the pressure within a room or a building. The project prioritizes surface pressure, which varies with location, and depends on the mass of air or water vapor in the atmosphere. The GCM model will be a useful tool for the prediction of the non-dimensional logarithmic surface pressure.

Ventilation

The final piece of information that will be presented by the system is the ventilation of a room. Conventionally, ventilation refers to the intentional introduction of outdoor air into a building or a room as a means of controlling the quality of indoor air. In other cases, this process is intended to displace pollutants from the building's surface atmosphere. However, the main purposes of ventilation in this project are temperature control and dehumidification where necessary. Since the air balancing hood method will be used to measure humidity in buildings, this parameter will be expressed in terms of the rate of flow of air into the room or building under consideration.

User Class and Characteristics

The users of this product will be able to enjoy several functionalities with which it comes. The main functions that the system is expected to perform, as highlighted in the previous sections of this discussion, are the determination of the surrounding atmospheric conditions and temperature. The users should be able to retrieve adequate information about the temperature fluctuations within a given room. The room temperature of a given building or room at a given instance is given as the average of the various measurements of this parameter at different instances within a specific period of time. Since this information will be provided by the system, the user's responsibility if to take accurate readings of the displayed information and store them for further use and analysis. Other pieces of information that the user should be able to extract from the device include the surface pressure and the humidity of a building. The collected data can then be used to perform further studies with the principal aim of revealing the relationship between the various environmental parameters. This relationship, based on the project's

operational principle, determines the humidity fluctuations in a house. When compared against a predetermined baseline, it is be possible to tell whether such a building is subjected to dampness. The user will have the general access to the display systems or temperature, humidity, and atmospheric pressure. However, additional research will be needed to determine the main information of interest, which is the general level of dampness of a room or a building. Thus, the customer will be able to perform the functions below:

Measure room temperature

Measure atmospheric pressure

Measure humidity

Perform an algorithmic manipulation of the data obtained from the above steps to determine the relative value of a room's humidity against an established baseline.

Operating Environment

The operating system for the pressure, temperature and humidity analysis system is in accordance with the following list:

- A data collection system
- A data analysis system
- User interface
- An algorithmic for analyzing data
- An algorithm for benchmarking the analysis results with a predetermined baseline
- A computer system with a windows operating system
- A python programming environment
- R studio for data analysis
- BME280
- Raspberry pi/Arduino uno
- Arduino uno

Design and Implementation Constraints

The design process will be implemented through python coding and data analysis. The collected data will be analyzed using R studio to determine the relationship between the measured parameters (temperature, humidity, and atmospheric pressure). This way, it will be possible to make accurate predictions of the level of ventilation in the buildings or rooms in which the system will be implemented. This statistical relationship that emerges from this analysis will be used to develop an informed insight into the scenario to make it more generalizable to different locations that are geographically isolated. To ensure that the Raspberry pi/Arduino uno performs the intended functions, it requires a code with the desired algorithm. Python coding will be used to create the code that is expected to control the activities of this hardware. Even though the main objective of this project is to

solve the problem of dampness in buildings, its scope is limited to the design of systems that can help to monitor any changes in the temperature, humidity, air pressure, and ventilation. The devise of practical corrective mechanisms is outside the scope of this project. Overall, this project will develop a system that helps to predict the ventilation levels of houses or apartments to ensure that any unwanted fluctuations in ventilation, room temperatures, humidity, and surface pressure are easily detectible.

Assumptions and Dependencies

For a practical and successful attainment of this project's principal objectives, certain assumptions must be made. Such assumptions help to reduce the complex nonlinear problem into a simple form that can be linearized. The main assumptions used in this project are in accordance with the following list.

- Only temperature, pressure, and ventilation affect the humidity of a building.
- The rate of flow of air into a building is a flawless method of measuring the humidity of such a building
- There is a direct negative correlation between the humidity of a room and the overall ventilation of such a room. This argument is based on the principal that ventilation helps to dehumidify a room or a building.

Requirements Capture

Even though the research stage involves understanding the concepts and the resources needed for the implementation of the project, it does not provide a deeper insight into the requirements of the project. During this stage, the researcher will evaluate the tasks that constitute the project and determine the most suitable resources for their implementation. This stage will also enhance a proper understanding of the software and hardware that will be used in the project. It will also help the researcher to understand the role of each of these software and hardware resources. The list below highlights the main hardware and software components of the project and how they will be used in the project.

- A Raspberry pi/Arduino uno: This project will settle for a raspberry that is characterized by either built-in wireless connectivity or a Wi-Fi dongle.

- A BME280 will be used as the project's main sensor for pressure, temperature, and humidity.
- R studio will be used to build and run the python program

Implementation

The Raspberry pi/Arduino uno can only perform specific functions if directed using specific codes that describe the roles that are intended by the user. Therefore, the first step to the application of this device will involve the creation of the codes. This task will be followed by the installation of all the necessary libraries to enhance flawless connection between the Raspberry pi/Arduino uno and BME280. R studio will be used as the main interface on which this process will be undertaken. Another important task that will be performed at this stage of the project is the Gathering the data collected from the test and then using the KDD methodology approach on the data collected to final make dampness decision on a house or apartment.

Prototyping

The creation of a prototype is another part of the project that will be considered before the actual implementation of the final product. The main role of the prototyping phase is to test the usability and value of the product to the end user (McElroy 2016). This process will also provide insights into how the level of utility that the end user will be able to obtain from the product. This way, it will be easier to make improvements based on the flaws that will be identified during this stage of development. The prototyping stage, which will involve the testing of the functionality and efficiency of the product, will be undertaken before the midpoint of the project's operational lifespan. Improvements will be implemented before proceeding to the final stage of the product development. Overall, the prototyping stage will help to gain a prior insight into the strengths and the weaknesses of the product before it is produced.

Project Management

The approach I'm most comfortable with when it comes to project management would be a scrum methodology with weekly/twice weekly tasks that must be

completed by the end of the week. Review what went well, what did not and implement that back into the planning process

6.5 Special resources required

The special requirements of this project can be divided into software and hardware components. It also entails the proposed technologies that are expected to aid the implementation process. Below is a list of the software and hardware resources that will be used in the project.

Software

The software that will be used for this project are;

- R with Rstudio
- Python with Rstudio
- Excel

Hardware

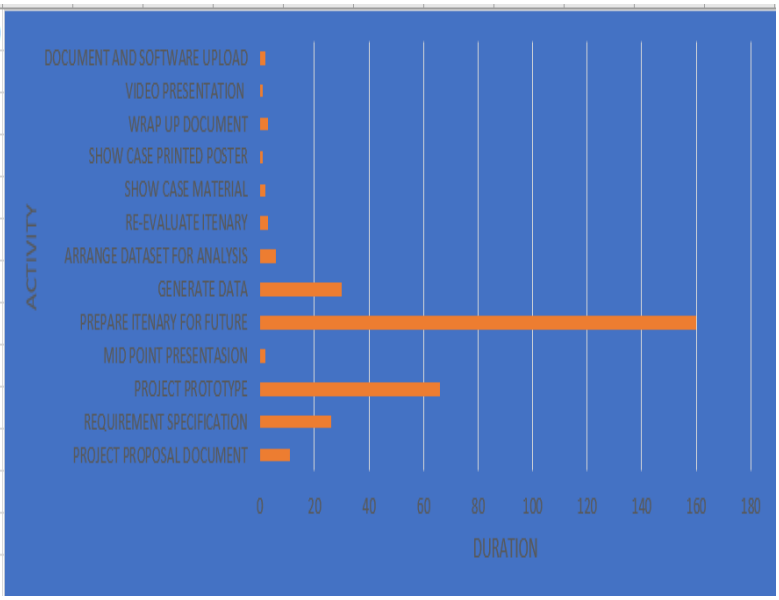
- Arduino uno.
- BME280, will be used as pressure, temperature, and humidity sensor
- A computer to build and test the program codes for errors.

ITEM	PRICE
Arduino-uno (https://store.arduino.cc/arduino-uno-rev3)	€20
BME280	€9
Raspberry-pi	€40
Soldering kit	€16
TOTAL	€85

6.6 Project Plan

GANTT

ACTIVITY	START DATE	SUBMISSION-DATE/END DATE	DURATION(DAYS)
PROJECT PROPOSAL DOCUMENT	20/01/20	31/01/20	11
REQUIREMENT SPECIFICATION	02/02/20	28/02/20	26
PROJECT PROTOTYPE	05/03/20	10/05/20	66
MID POINT PRESENTASION	17/05/20	19/05/20	2
PREPARE ITENARY FOR FUTURE	20/05/20	27/10/20	160
GENERATE DATA	28/10/20	27/11/20	30
ARRANGE DATASET FOR ANALYSIS	28/11/20	04/12/20	6
RE-EVALUATE ITENARY	05/12/20	08/12/20	3
SHOW CASE MATERIAL	09/12/20	11/12/20	2
SHOW CASE PRINTED POSTER	12/12/20	13/12/20	1
WRAP UP DOCUMENT	14/12/20	17/12/20	3
VIDEO PRESENTATION	18/12/20	19/12/20	1
DOCUMENT AND SOFTWARE UPLOAD	20/12/20	22/12/20	2



Proposed Technologies

The proposed technologies comprise of a set of technical skills that will be used to implement various aspects of the project. Such tasks include the collection and analysis of data and the creation of the necessary codes. The main technologies that will be used in the project include the following:

- Python
- R Data Science Language & RStudio
- Tableau

- Raspberry pi/Arduino uno
- Arduino uno
- Adafruit BME280

6.8 Evaluation

As highlighted in the introductory section of this proposal, the project's main objective is to reduce the level of dampness or avoid dampness totally in a house or apartment. The functional efficiency of the product will be evaluated by assessing the accuracy or efficiency with which it undertakes the assigned tasks. Other factors that will be used to evaluate the product include usability, maintainability, availability, speed, reliability, safety, and security.

7 Data visualization and analysis

- Data summary.

```
> summary(BME280)
          TIME        TEMP.CELSUIS.    PRESSURE.hPa.    HUMIDITY...
 1:00:09 pm:   1   Min.   :15.18   Min.   :1002   Min.   :48.33
 1:00:29 am:   1   1st Qu.:17.04   1st Qu.:1003   1st Qu.:57.40
 1:01:09 pm:   1   Median :19.28   Median :1004   Median :60.80
 1:01:29 am:   1   Mean   :18.64   Mean   :1004   Mean   :61.29
 1:02:09 pm:   1   3rd Qu.:19.73   3rd Qu.:1005   3rd Qu.:63.11
 1:02:29 am:   1   Max.   :24.21   Max.   :1006   Max.   :89.59
 (Other)   :1438
```

For the 24hours period of this dataset, we see from the result above that the maximum temperature is 24.21*C and the minimum temperature is 15.18*C, while for pressure, the maximum pressure of the room is 1006hpa and a minimum room pressure of 1002hpa, also for the humidity, the maximum humidity of the room is 89.59% and the minimum humidity of the room is 48.33%.

- Test for Normality

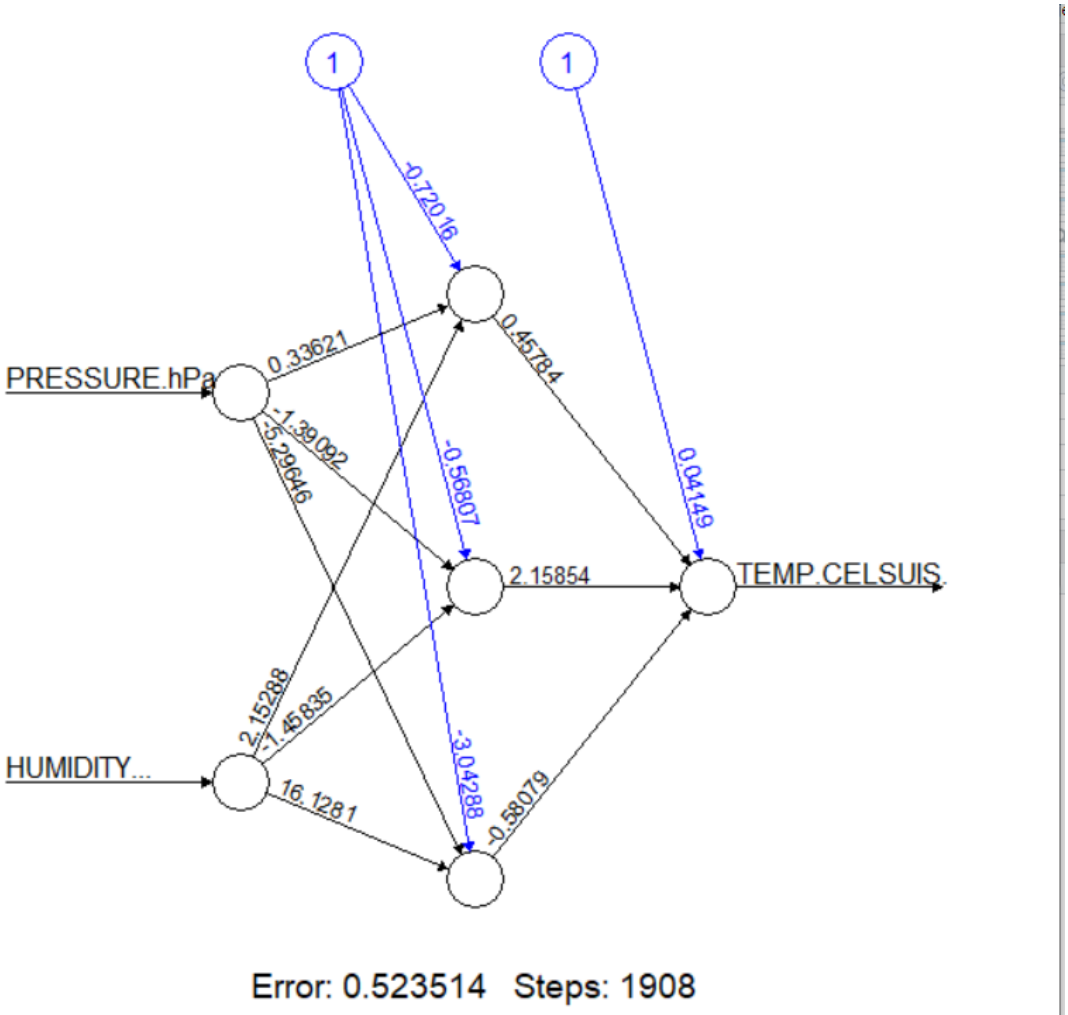
```
> # Tests for Normality
> #
> shapiro.test(BME280$TEMP.CELSUIS.)

        Shapiro-Wilk normality test

data:  BME280$TEMP.CELSUIS.
W = 0.90626, p-value < 2.2e-16

> shapiro.test(BME280$PRESSURE.hPa.)

        Shapiro-Wilk normality test

data:  BME280$PRESSURE.hPa.
W = 0.87996, p-value < 2.2e-16

> shapiro.test(BME280$HUMIDITY...)

        Shapiro-Wilk normality test

data:  BME280$HUMIDITY...
W = 0.93636, p-value < 2.2e-16
```

The test for normality is conducted using Shapiro-Wilk's method, From the result shown above p-value > 0.05 for out three variables temperature, pressure and humidity, this implies that I can assume the normality of the three data.

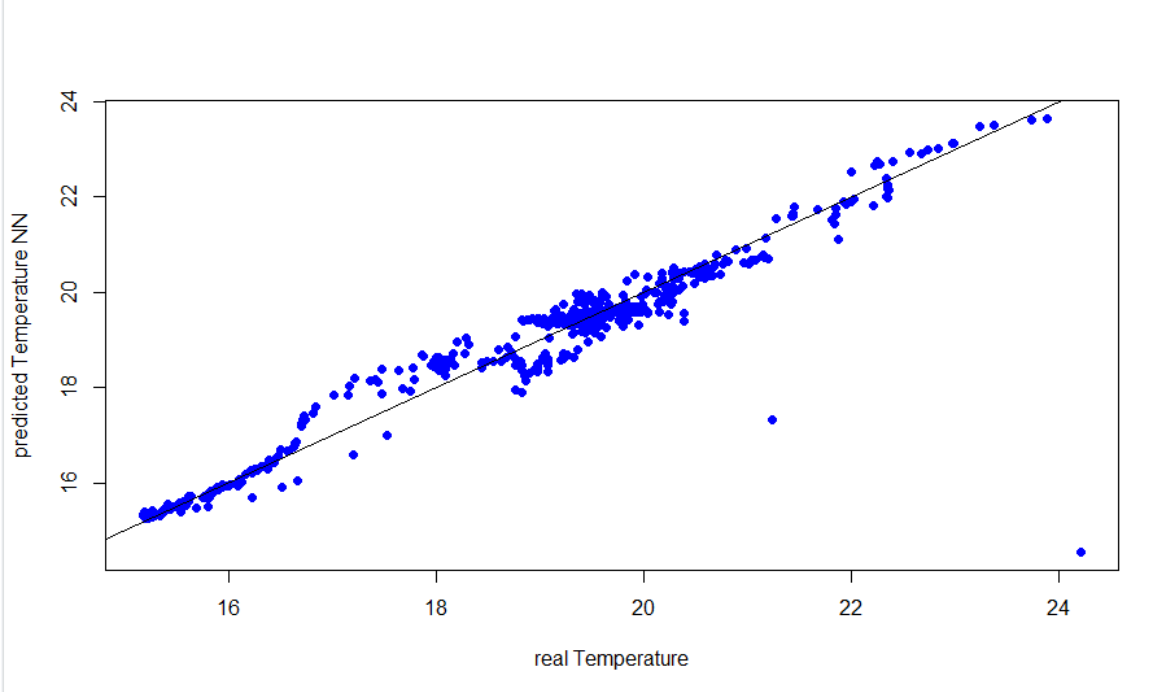
- Artificial neural network (ANN) model.

Prediction of temperature using neural network model.

```
## Fit neural network

# install library
install.packages("neuralnet ")

# load library
library(neuralnet)

# creating training and test set
trainNN = scaled[index , ]
testNN = scaled[-index , ]

# fit neural network
set.seed(2)
NN = neuralnet(TEMP.CELSUIS. ~ PRESSURE.hPa. + HUMIDITY... , trainNN, hidden = 3 , linear.output = T )

# plot neural network
plot(NN)
```



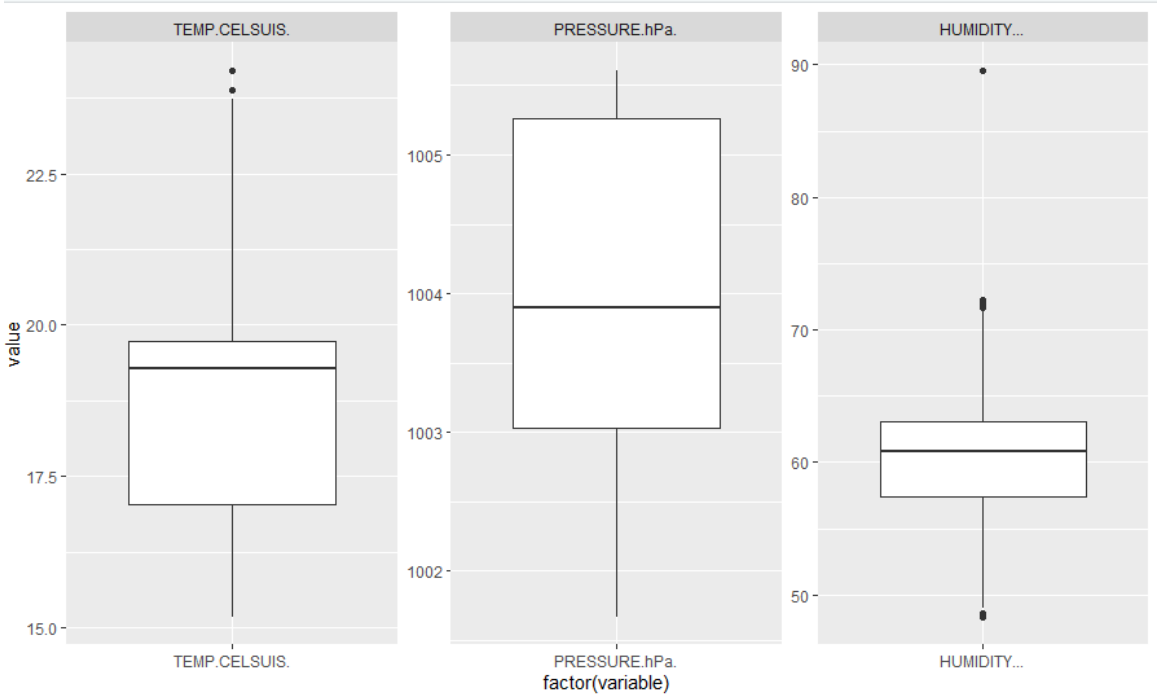
The visualization above compute neural network, this model has 3 neurons in its hidden layer, the lines shows the connections between the neural while the blue line is the displays the bias term.



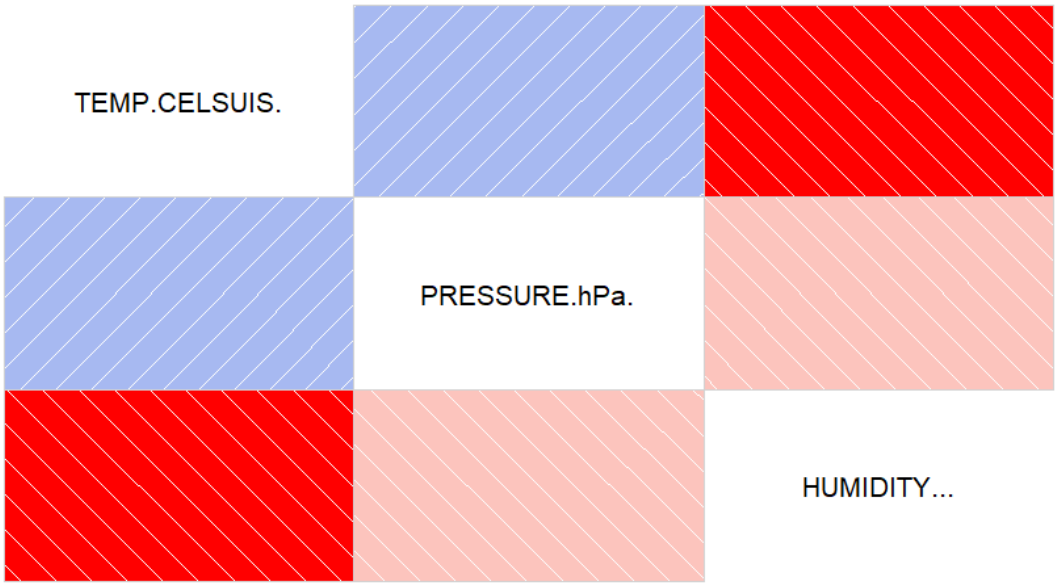
The above shows a comparison of the predicted temperature with the real room temperature.

- simple linear regression model.

Analysis was based on capturing the correlation and prediction model on the Temperature variable using the simple linear regression model on RStudio.



The above shows outliers on each of the variables, as shown, Pressure data is only one with no outliers.



The above illustrate the correlation between our variable, as show we see that all variables are highly corelated to each other.

```
> # Printing the model object
> print(lmModel)

Call:
lm(formula = TEMP.CELSUIS. ~ ., data = train)

Coefficients:
  (Intercept)  PRESSURE.hPa.     HUMIDITY...
     -76.5985         0.1146         -0.3231
```

The above output represents the linear model, the intercept in the above represent the minimum value of temperature that will be received, if all the variables are absent or constant.

```
> summary(lmModel)

Call:
lm(formula = TEMP.CELSUIS. ~ ., data = train)

Residuals:
    Min      1Q  Median      3Q     Max
-1.4528 -0.3005 -0.0453  0.4013  2.2242

Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)   -76.598536  18.729182   -4.09 4.72e-05 ***
PRESSURE.hPa.   0.114554   0.018597    6.16 1.12e-09 ***
HUMIDITY...    -0.323079   0.003839  -84.16  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.5853 on 863 degrees of freedom
Multiple R-squared:    0.9,     Adjusted R-squared:  0.8998
F-statistic:  3885 on 2 and 863 DF,  p-value: < 2.2e-16
```

In the above output, **Pr(>|t|),** this represents the p-value which then be compared against the alpha value of 0.05 to ensure the significant of the model.

Multiple R-squared explain that the intercept of the pressure and humidity variables, when combined can explain 90% of the variance in the temperature of the room. The R-squared value usually lies between 0 to 1, if the R-squared value is higher that 0.70, we then consider it a good model. Therefore, in this case the R-squared value is 0.900, so I consider this model a good model.

7.1 Final GUI

The final GUI is a bit different from the original concept as shown above, it is the simplified version that is much handier for the client to use. This consist of

Home page, registration/login page, SLM page, ANN page and contact page, which displays the collect info from the Arduino uno.

This page will give users two different options SLM and ANN page. When any of this option is chosen, it displays the analysis result on the data in a virtualized format as shown below. Users are also able to download the data generated for free once registered on the website from the profile page.

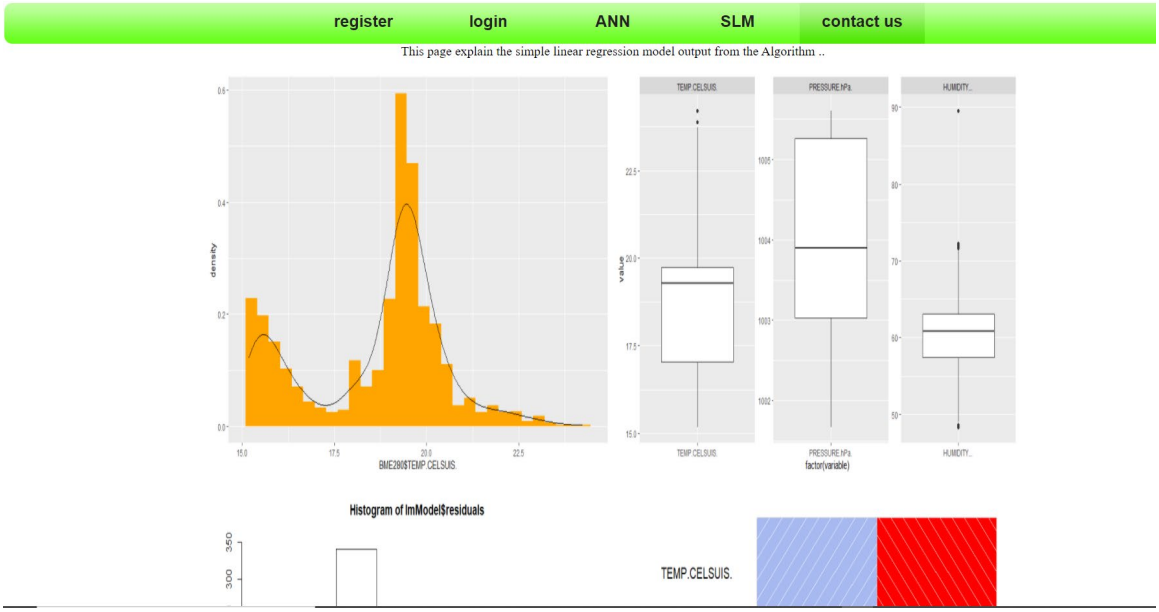
Home page

Contact page

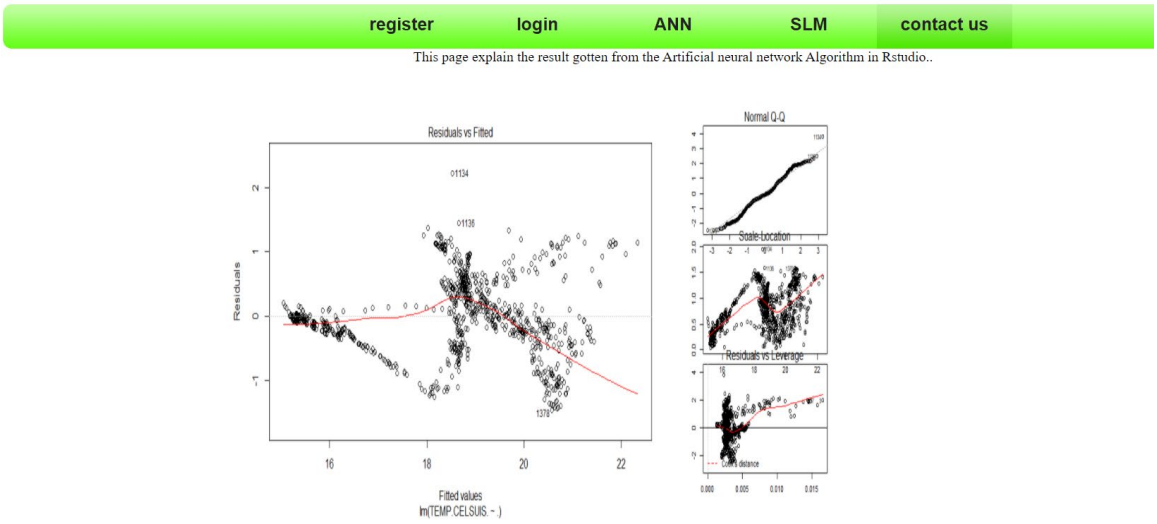
Email : x13111434@student.ncirl.ie
Phone : 0188955465

Address : Mayor Street Lower,
International Financial Services Centre,
Dublin

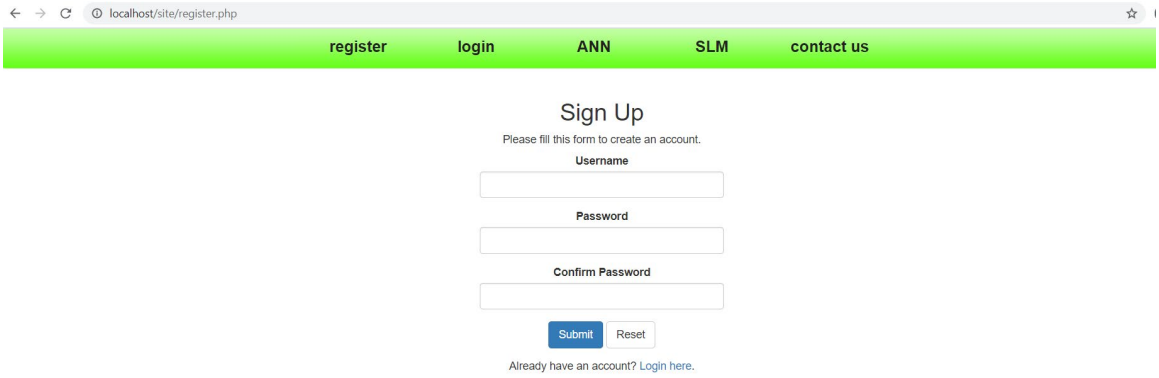
SLM model page



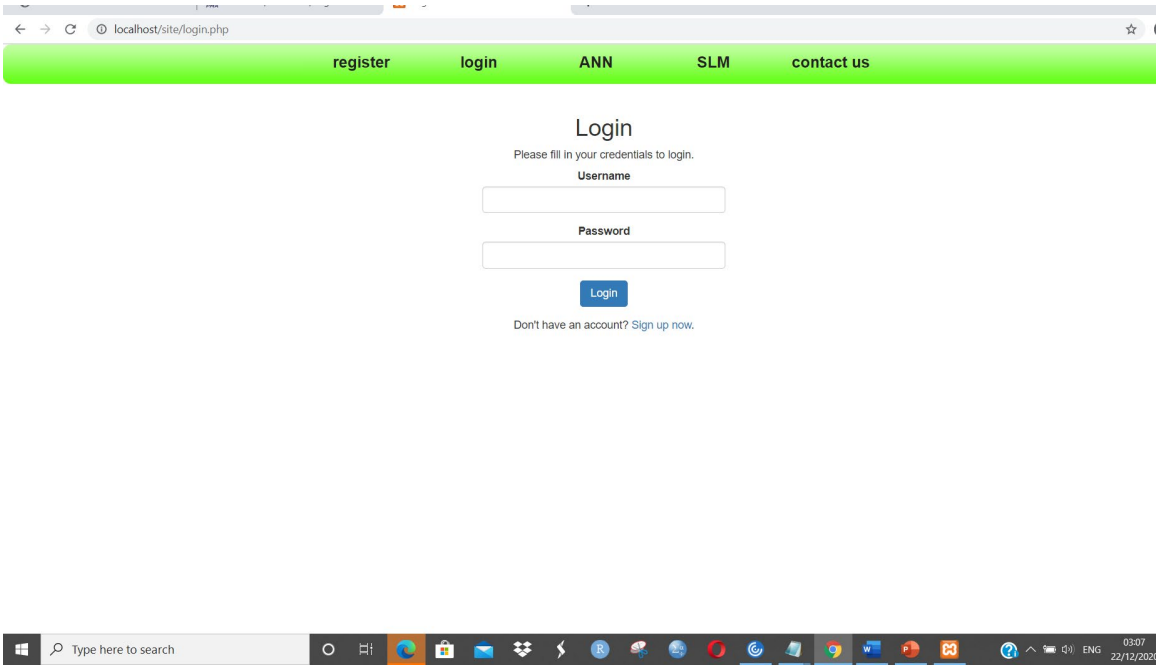
ANN model



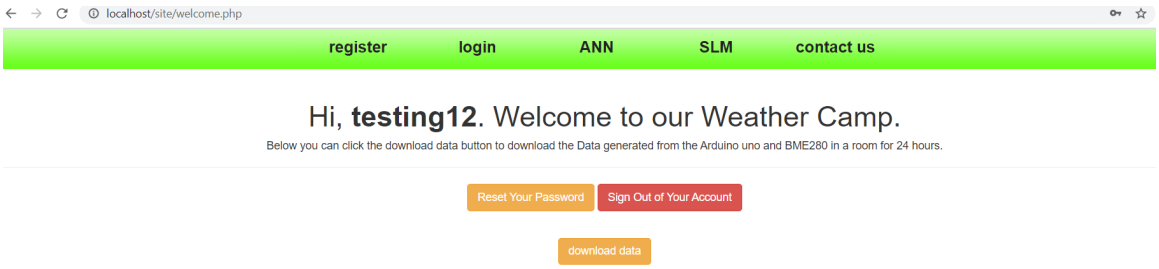
Registration page



Login page



Profile Page



7.2 Testing

The first stage of testing was checking the precision accuracy of the BME280 sensor, how it was reading the pressure, temperature, and humidity in the room.

This was derived by setting up Arduino uno and BME280 in a room where the BME280 sensor was reading, computing, and sending the result to the Arduino IDE. The findings where the BME280 sensor was never more than .2 of the readings.

The second stage of testing was checking how end users can interact with the Arduino uno interface and bme280, this involves the connection of the Arduino uno and BME280 sensor, how to install relevant libraries on the Arduino uno IDE, how to turn on the hardware, and activate the wires to detect the sensor readings.

8 Monthly Journals

Reflective Journal 1

Student Name	Oluwatobi Toheeb Olajire
Student Number	X13111434

Programme	Bsc Honours in computing (stream: Data Analysis)
Journal Month	November

My Achievements

This mount, most time spent on brainstorming on the final year project idea, so it can be done and presented to my lecturers or appropriate department. I came up with an idea that will help me miss to skill together, which are, internet of things and data analyst. The idea is an analysis of temperature, pressure and humidity using BME280 and Raspberry pi in a room in order to analysis what room temperature is best to avoid/prevent dampness. Also, this application would be useful for builders to help them analysis the best ventilation level for an apartment while still under construction.

My Reflection

Was a challenging start of the year as I started 10th week into the first semester due to poor communication with the college and bed email server. It was a hard task to try to come up with an absolute unique idea for the project, as most of the ideas discovered were already available searching online and they contain similar qualities to the idea that I came up with. BME280 and raspberry pi temperature, pressure and humidity analysis already exist with various analysis of similar nature are available but during my research I realized most did not further apply the machine learning algorithms on the data derived from the project, therefore I have

decided to progress by apply three different machine learning algorithms to the

Student Name	Oluwatobi Toheeb Olajire
Student Number	X13111434
Programme	Bsc Honours in computing (stream: Data Analysis)
Journal Month	December

derived data to further virtualize and see different patterns in the data.

Intended Changes

All required changes will be made once I have pitched my idea and supervisor have giving feedback. I will be adding a website to the project in order to display my analysis in a easy format to make for ease understanding.

Supervisor Meeting

Once I have been assigned a supervisor, I will need to arrange for a meeting with my supervisor.

Reflective Journal 2

This month, my project An analysis of pressure, temperature and humidity in a room using a raspberry pi and BME280 got approved, I also got assigned a supervisor this month. Met with my supervisor and I was happy with the feedback on the project idea then I begin with the project proposal.

My Achievements
My Reflection

At the beginning of this month, my project was not approved, this was because my supervisor suspect I did not have enough understanding of the idea, so I had to book an appointment with him to explain further. Friday 06/12 at 15:00 was my first appointment with my supervisor discussing on how to proceed with the project. At the appointment, after I finally explained the project idea to my supervisor on how the data will be generated and what I think will be performed on the data, he was

not fully certified, so he gave me few tips which I took to note, then I started gathering project hardware requirements.

Intended Changes

After finishing the project proposal, I extended my research even more on the growth and cause of damp in a room and discovered that most dampness in a room are caused by poor ventilation and a room with potted plants is most likely to yield to the start of dampness in the room. I then proceed with my research, I found a sensor that is able to check the moisture level of the soil of the plant in the room, so I will discuss this with my supervisor if the moisture level of soil in a room can be added, if approved will then be added to my project proposal for final submission in August.

Supervisor Meetings

My supervisor is Sachin, first meeting was scheduled for Friday 06/12.

My Achievements

Reflective Journal 3

Student Name	Oluwatobi Toheeb Olajire
Student Number	X13111434
Programme	Bsc Honours in computing (stream: Data Analysis)
Journal Month	January

This month, I was able to purchase all hardware needed to get the data for analysis, while I wait for shipment and delivery of the hardware, I started developing the idea for how I would like my prototype to be, the prototype will be a sensor that read data, store the data on the Raspberry pi and display the analysis on a website.

My Reflection

This month was busy month as I got two exams and most of my other modules assessment was due this month as a result from my late starting of the semester all missed assessment due date was moved to January submission including my Midpoint presentation for this module. Was a hard task developing the requirement documents, I struggled with the use case diagram, functional requirement, the use cases and the class diagram for the system architecture, as I only had my hands on them in first year which was 3 years ago had to recap my memory. Adding the hardware requirement made it more challenging as its my first time dealing with hardware (sensor and raspberry pi) in the college project.

It was difficult to focus on the requirement documents as there was lot of college work to do for me this month. I found myself spending most time on other modules as I needed more time studying since I had missed plenty of lectures for the 2 Exams, I had this month. The requirement document was rushed and finished on the day it was due, so I had less time to super investigate my write up before submission.

On the day of the Midpoint presentation, I was early enough to prepare for the presentation, was successful with the presentation but got a bad feedback on my requirement document as the lecturers could tell my work rushed so I explained my situation to them due to my late start of the semester and I was giving an extension and new submission date.

Intended Changes

I will need to rebuild my project plan and start my work from start again as my requirement document is not properly formatted and now, I have enough time to

Student Name	Oluwatobi Toheeb Olajire
Student Number	X13111434
Programme	Bsc Honours in computing (stream: Data Analysis)
Journal Month	February – march

get all documentation right.

Supervisor meetings

No supervisor meeting this month due to the Midpoint presentation that was done this month, my supervisor Sachin was part of the lectures in the midpoint presentation.

Reflective Journal 4

This period, I was able to complete the requirement documents and the technical report, also finishing the midpoint presentation documents. I have now started to do research on the suitable machine learning algorithms for the project.

My Reflection

My Achievements

This much was not that much of a struggle as I only had to follow up feedbacks giving from the midpoint presentation to final ease the completion of the requirement documents and technical report. The prototype for the project has been delayed due to late delivery of the hardware required, this late delivery is caused as a result of the Covid-19 virus in china which led to a huge delay in the delivery time of the BME280 and raspberry pi.

Intended Changes

As soon as delivery of the hardware come, I will try to run the python script with zero errors once the raspberry pi is powered.

Student Name	Oluwatobi Toheeb Olajire
Student Number	X13111434
Program	Bsc Honours in computing (stream: Data Analysis)
Journal Month	April - June
Supervisor Meeting	

Date of meeting:13/03/2020

Item discussed:

- Prototype
- Use case diagram
- Project plan
- Technical report
- Delay on delivery of BME280 and raspberry pi

Action items:

- Complete the requirement documents.
- Send report to the supervisor

Reflective Journal 5

Throughout the past months, I was able to look over and complete the design documents and finished the registration and sign-in section of the website. Also successfully complete the midpoint presentation documents and video.

My reflection

My Achievements

Due to Covid-19 the midpoint presentation and prototype show case was converted to a personal video submission. The mid-point presentation and prototype showcase video both went well, I got my result, and I did well but not the best had 66/100. I also got feedback from my submitted work. As a result of delayed delivery of the hardware I had to ignore some part of the prototype description in the video.

Intended Changes

Next month, I will make sure I get my hardware working and the prototype fully active and running fine with the python codes.

Supervisor Meeting

Date of Meeting: 16/06/2020

Item discussed:

- Requirement documents
- Prototype
- Machine learning models
- Roc curve

Action items:

- Complete the requirement documents
- Adding advance machine learning to the models as advice by supervisor
- Think about evaluation of the project

Reflective Journal 6

Student Name	Oluwatobi Toheeb Olajire
Student Number	X13111434
Programme	Bsc Honours in computing (stream: Data Analysis)
Journal Month	July-August

My Achievements

This month I was able to order new hardware which led to a successful data generation. In August I discovered that the Raspberry pi and BME280 was not connecting and generating the data required due to imbalance in the Voltage connection, so I decided to use a similar hardware to the Raspberry pi which is the Arduino uno.

My Reflection

As I have encountered many problems in generation my data and establishing a successful connection between the Raspberry pi and BME280, this had made me research on similar hardware to get the job done as I was spending too much time trying to fix the same error.

The python script could not detect the I2c interface while this interface was active on the Raspberry pi, this was the major error as the Raspberry pi cannot read the sensor without the I2C interface active. I had ordered Arduino uno in replacement for the Raspberry pi.

During this month, I was faced with some mantel issues which had led me to have to access to any on my project work and other college stuff that was due in August for submission, so I had to extend the submission till December.

Intended Changes

I intend to change the Hardware in charge of data generation and make sure time spent on building the code is less this time.

Student Name	Oluwatobi Toheeb Olajire
Student Number	X13111434
Programme	Bsc Honours in computing (stream: Data Analysis)
Journal Month	Sept-December

Reflective Journal 7

My Achievements

This month I was able to generate my data and made a successful connection between the new hardware Arduino uno and BME280, I achieved this by discovering Adafruit libraries available on the Arduino uno IDE. I have also completed most of the analysis and documentation.

My Reflection

I felt working with the Arduino uno is going well. It is more user friendly as it comes with varieties of libraries to help ease hardware connections.

Intended Changes

I intend to get all section working fine before the submission date.

Supervisor Meeting

Date of Meeting: 08/12/2020

Items discussed:

- Data
- Advance analysis
- Final document submission

Action Items:

- Generate correct data
- Send completed report to supervisor
- Think about evaluation of the project

9 References

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