

# Smart Environmental Monitoring System

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**Abstract:** The level of Global temperature is rapidly increasing, which is gradually spoiling our Planet Earth. If Carbon dioxide's curve slingshots above the normal range (250-400 ppm) it will be a turmoil, it may lead to potential health problems. Global health or A Nation's Health can be word-pictured by the health of the citizens of the Nation, and the wealth of the nation can be portrayed by the environmental condition and natural resource. But most of the species are extinct due to the climatic change. 7% of the deaths in Nations like India are due to respiratory issues. While the people are suffering due to the Air which cannot even be visualized by the Victims, people are dying to the Man-made Natural phenomena Sound. In India that has led to serious health threats like hearing loss, increasing stress levels, behavioral and mental problems, insomnia, heart ailments, hypertension, and many more. During the grave situation, we came up with a Compact System which could collect all data relevant to the environmental factors. Using the data from the device we can provide a valid recommendation to a region. Using the GPS the device could generate data of the city using the collection of data taken from different places of the city. This system monitors environmental factors like Temperature, Humidity, Atmospheric Pressure, Light Intensity, Acoustic Intensity, presence of Carbon dioxide (CO<sub>2</sub>), and presence of Hazardous Gases. Using Multiple Nature of Data of a place and collective data in a region. The system uses the Big Data and recommends the measures to be taken based on the 'Sustainable Development Goals' (SDGs) of the United Nations.

## I. PROBLEM STATEMENT

### A. Impacts on Human Wealth Resources:

The radiation from a planet's atmosphere warms the Earth's surface to above temperature what it would be without this atmosphere. The burning of fossil fuels and cutting of trees has accelerated the greenhouse effect and caused global warming. The burning of fossil fuel and other activities such as cement production and tropical deforestation may increase the containment if Carbon dioxide(CO<sub>2</sub>), Nitrous oxide, and methane in the atmosphere. According to the 2014 Assessment Report from the Intergovernmental Panel on Climate Change, "Atmospheric concentrations of carbon dioxide, methane, and Nitrous oxide are unprecedented in at least the last 800,000 years. This may lead to Ozone Depletion, this reduces the moisture and increases the Heat, This affects the growth of crops like vegetables and herbs namely Brussels sprouts, cabbage, carrots, cauliflower, celery. The major means of natural pollination is accomplished by Birds, but the noise in the region causes Birds to migrate to other Environments. The louder the noise from gas compressors, 'the lower the birds' baseline Corticosterone levels. This may lead to miscarriage in the fetus. It is Pandemic.

### B. Impacts on Human Health:

The penetrating radiation from the Sun through the Stratosphere typically causes potential health issues. Human Thermos-Regulatory capacity is exceeded. This response to heatstroke, hypothermia, and harmful effects. It is one of the leading environmental health risks in humans. Moisture lagging environment will cause Respiratory Disease and many patients' efforts to breathe properly. Sudden and Huge leads to stress, poor concentration, cardiovascular disease, cognitive impairment, and hearing loss. According to The Hindu Newsstand, the Polluted atmosphere reduces the visibility for the drivers leads to many accidents in and around capitals like Delhi, India.

### C. Big Data for Climate Casting.

Based on the algorithms and fewer data collected from the remote place i.e., using Satellite about the weather of a region, weather forecasting is usually done. Traditional weather forecasting Method is an inaccurate Prediction.

## II. SYSTEM OVERVIEW

### A. Detection Unit:

#### i) Temperature:

The Temperature sensor (DS18B20) records the temperature rise due to the increase in voltage and if there is a voltage drop between the transistor terminals of base and emitter.

#### ii) Humidity:

The humidity sensor DHT11 measures both moisture content area and air temperature. Based on the humidity of the ambient air thermal sensor conducts electricity.

#### iii) Atmospheric pressure:

The barometer BMP180 the air pressure sensor. It acts as a transducer that converts the signal from one form of energy to another form. This sensor delivers the uncompensated value of pressure and temperature.

## iv) Light Intensity:

The Ambient light sensor BH1750 which indicate the intensity of daylight or artificial light. They convert light energy to electrical signal output.

v) Presence of CO<sub>2</sub>:

The MQ-135 gas sensors are used to detect the containment of carbon dioxide and monitoring of quality, freshness, and safety of agricultural and food products and detect changes in the air quality. The MQ-135 can detect a wide range of gases, including NH<sub>3</sub>, NO<sub>x</sub>, alcohol, benzene, smoke, and CO<sub>2</sub>.

## vi) Acoustic Intensity:

Typical sound detecting sensors cannot be used for this system since the requirement of the system is the range of the Acoustic in the environment. Instead, Microcomputer's micro USB Mic(Fig 1) can be used.



Fig 1

Fig 1.1

## vii) GPS:

Global Positioning System is a satellite-based navigation system that detects the forecast changes in the environment.

## viii) Hazardous Gas:

This sensor(MQ-2) is sensitive for flammable and combustible gasses such as Methane, Butane, LPG, smoke.

### III. WORKING AND OPERATION UNIT

## A) Conversion and Storage:

The sensors connected to R Pi which saves the temperature in Celsius and Fahrenheit in a .txt file format and analyze the date and time information. GPS transfers the data between the programs and all over the networks in .XML file format. A Sensor which observes the intensity of light will save the data in a .ldt file. The presence of CO<sub>2</sub> level in the air records the data in .svg file format. The level of air pressure and humidity stores tabulated data in .csv file format such as a spreadsheet or database. The intensity of sound is stored in an audio bitstream in .wav file format. This data collected in R Pi, this microcomputer will store the data in a spreadsheet.

## B) Modes of Operation:

A Single pole Double Throw (SPDT) Fig 2 switch can be used for shifting between the two modes. A manual based operation could be user friendly.



Fig 2

## i) Instance Detection:

For the manual operation for this system, a Push button(fig 3) is planted in the System. During the Instance detection mode supply to the GPS will be in cut-off condition. Since every sensor detects it's a property for every second, this makes travail for recording appropriate data. So, in the code for the execution, of this system Time Module will be imported into the Algorithm. For every 5 seconds, the system will detect the information, the initial value will be stored in the Spreadsheet.



Fig 3

## ii) Traverse Detection:

In the previous model, the data at the instant of usage of push-button will be detected and processed. In this mode, a data of a huge landmass can be detected, in this, the GPS module will be turned on, the microcomputer will be coded to record and flag the data at every instant when the push button is triggered. The flagged co-ordinates of the GPS at every instant will be interfaced with the 'Garmin Software(fig 4.1) when the survey of the huge land is taken, the outermost flagged point will be taken as the boundary of the survey area. An Average of each data at every instant will be used for the final output.

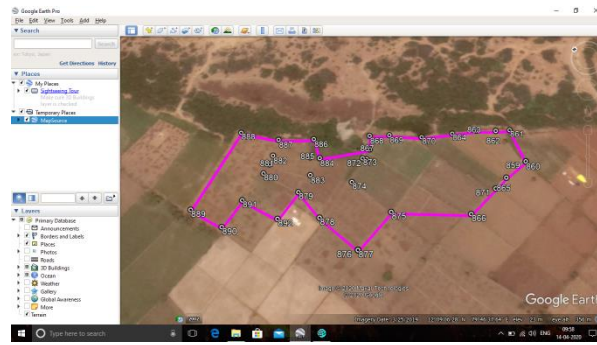


Fig 4.1 Screenshot of Gmin Software, with boundaries of the survey.

C) Interfacing Garmin Application with Raspberry Pi

The Garmin uses ANT+ Technology to send the GPX files from device to device. For this operation, Some packages have to be installed in the Raspberry pi.

```
apt-get install lockfile-progs liblockfile1
apt-get install pmount
apt-get install inotify-tools
apt-get install git
```

Fig 4.2 Commands to install the requires packages in the R Pi

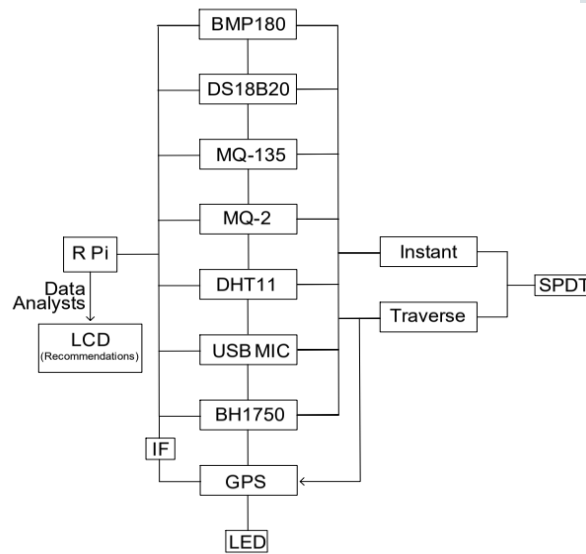
Consequently, we're going to install 'usbmount' which will mount the Garmin's without running the desktop and gives control over how they're mounted.

```
git clone https://github.com/rbrito/usbmount cd usbmount/
dpkg-buildpackage -us -uc -b
cd ..
dpkg -i usbmount_0.0.24_all.deb
```

Fig 4.3 Installation of Garmin in R Pi

For this operation, it requires R Pi to act as a Wi-Fi access point, a Smartphone as to be connected. Using these GPX files will be retrieved from the R Pi, the Smart Phone will display the region of the data taken in the Traverse Detection Mode.

IV. BLOCK DIAGRAM



A) Block diagram and Algorithm Explanation:

The LED will tend to glow only if all the sensors communicate with the microcomputer, the operator could recognize the system is working properly, during the survey. For the two modes of the system, two classes can be declared. SPDT switch can be used to shift between the classes. If it is switched to traverse mode, the GPS also triggered to store the data, every factor from the sensors will be stored in each set of data respective to its Co-Ordinate. When all the sets of data are taken using either instant or traverse method, the data sets will be taken into Data analysts, based on the fed range of the data the system will determine the Safe and harmful range of the factors. To make this system so user friendly the detected parameters or factors will not be displayed in the LCD instead a fed recommendations will be displayed and also it will highlight the most harmful parameter which must have to ratify.

## V. SCHEMATIC SETUP

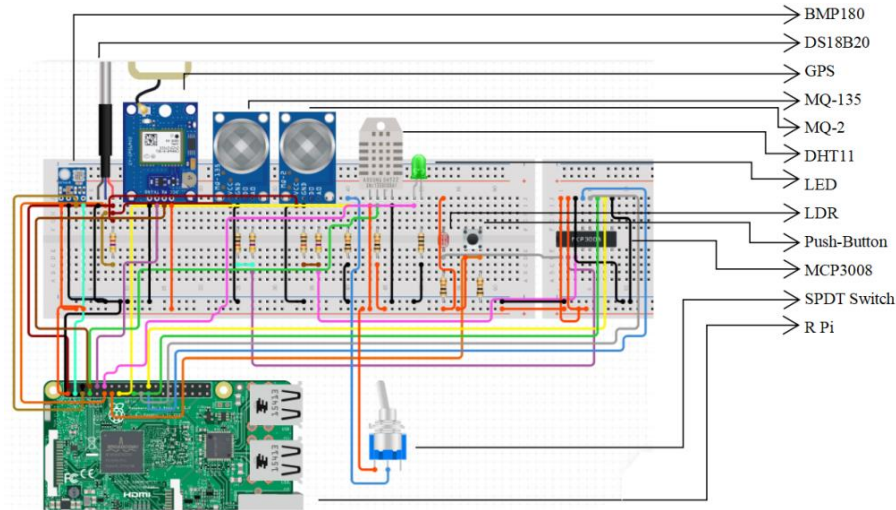


Fig 5 Simulated design of the System

A) *BMP180*

Initially, R Pi 3v is connected to BMP180's VCC, Atmospheric Pressure sensor [BMP180]. BMP180's GND is connected to BUS GND, then the BMP180's SCL is connected to R Pi's GPIO3. R Pi's GPIO2 connects with BMP180's SDA respectively.

B) *DS18B20*

R Pi GND and DS18B20 GND are short-circuited and connected to BUS GND. DS18B20's VCC(5v) is connected to the 4.7k ohm resistor. DS18B20's DATA is connected with Gas sensor (MQ2)5v.

C) *GPS Module*

GPS's VCC terminal is connected to BUS GND. GPS's RX (UART receive pin) connects to R Pi's GPIO15. GPS's TX (UART transmit pin) connects to R Pi's GPIO14. GPS's GND is connected with BUS GND.

D) *MQ2 & MQ 135*

MQ2 & MQ 135's VCC is connected to R Pi's 5v. 3.2 ohm and 4.7ohm are short-circuited respectively.

E) *DHT11:*

The Humidity's(DHT11) VCC connected to BUS POS 1 and DHT11's DATA connects to R Pi's GPIO4. DHT11's GND connects with BUS GND.

F) *LDR :*

One leg of the LDR is connected to the BUS POS 1 and another leg is connected to the BUS POS 2 with 10 k ohm resistor respectively.

G) *MCP3008 :*

This IC will add 8 channels of 10-bit analog I/p to the microcomputer (R Pi). In this system, chip's D in is connected to R Pi 10, CS is connected to R Pi 8, D out is connected to R Pi 9, CLK is connected to R Pi 11

## VI. EXPERIMENTAL SETUP

A Box with removable Top will be used as the Body of the System whenever the system needed to get the data, the top has to be removed for the accurate detection of the respective properties. The SPDT switch, LED, LCD, and Push-button will be situated on the other side of the exposure securely. The duty of the LED is to make sure whether all devices in the running condition. The system will be coded to trigger the LED only if all the sensors respond to the microcomputer. When the SPDT switch is left in Instant detection mode, the system will process the data and displays the recommendation at the instant. If the SPDT switch is in Traverse Mode, it will wait for the operator to click the push-button, again and again until the operator inverts the SPDT switch. When all the data is taken each data will be aligned with its Google Co-ordinates, So a recommendation for the Huge region will be displayed.

## VII. DATA ANALYSTS

When all the parameters from the Sensors fed into the Spreadsheet, the safety and harmful ranges of the parameters will be compared with the detected data. There are some reports which exclaim that the humidity percentage only between 30% to 70% is safe for people with respiratory issues. Comparing the real data and the fed data, the risk factor of the environment can be determined.

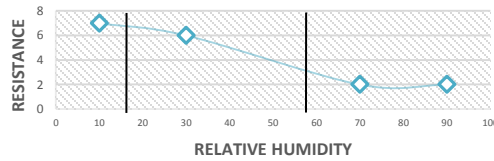


Fig 6 Plot between Humidity and Resistance, the output of the Humidity sensors.

The Noise above 70 dB over a prolonged period may start to damage your hearing. Loud noise above 120 dB can cause immediate harm to your ears. So, the Acoustic detection sensor will be coded to detect the dB initially, if it detects the sound around 70 magnitudes, the system will detect the acoustic for 10 more. If the system detects the noise of more than 120 dB the system will detect for 5 seconds. If the magnitude didn't fall, the system will declare it has a serious factor.

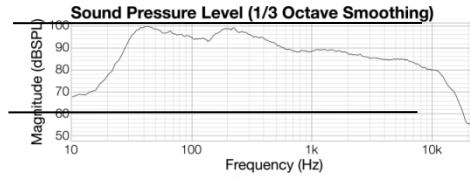


Fig 6.2 Plot between dB and Hz, the output from the USB MIC

Then the important parameter from the system is about the air, due to the increase of the ppm of the Co<sub>2</sub> the photosynthetic rate will affect. In concentrations up to 1% (10,000 ppm), it will make some people feel drowsy and give the lungs a stuffy feeling. Concentrations of 7% to 10% (70,000 to 100,000 ppm) may cause suffocation. The recommended safe exposure is between 350 ppm to 400 ppm.

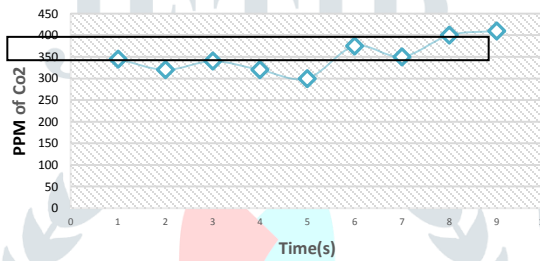


Fig 6.3 Plot of the PPM of Co<sub>2</sub> each second

As the pressure decreases, the amount of oxygen available to breathe also decreases. At very high altitudes, atmospheric pressure and available oxygen get so low that people can become sick and even die. Studies say that people are most comfortable with a barometric pressure of 30 inches of mercury (in Hg). When it rises to 30.3 in Hg or higher or drops to 29.7 or lower, the risk of heart attack increases.

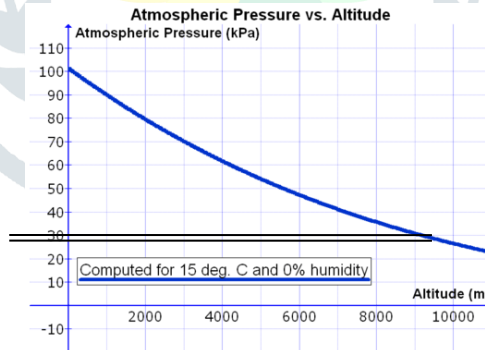


Fig 6.4 Plot between Atmospheric pressure and the Altitude.

The common denominator of Climate change is Temperature. 44 °C (111.2 °F) or more – Almost certainly death will occur. In most cases this much temperature will collapse Humans by shock, Brain damage, eventually fatal. Temperature between 28 to 37 will be safely surviving.

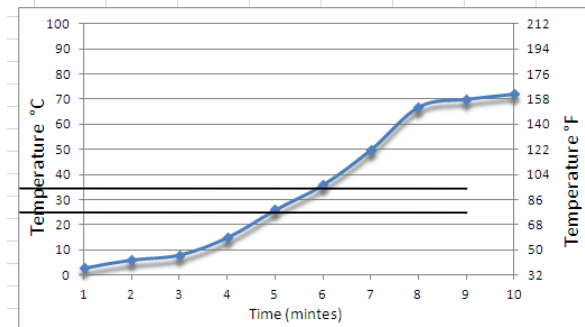


Fig 6.5 Plot between Time(m) and Temperature

For the sake of Plant growth photosynthetic process plays a vital role, for the light is the ultimate source. Plants use wavelengths between 400 and 700 nanometres (nm) for photosynthesis, which provides for all the energy needs of the plant.

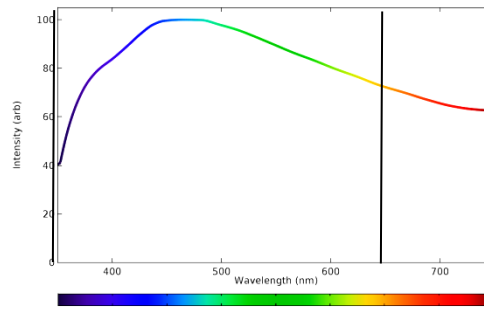


Fig 6.6 Plot between Intensity and Wavelength

#### VIII. TABLE of contents 1

Components	Power Consumption in $\mu\text{A}$	Cost Breakdown In (Rupees)	Nature of O/P
BMP180	3	145	csv
DS18B20	200	195	txt
MQ 2	150000	192	svg
MQ 135	150000	221	svg
DHT11	300	112	csv
USB MIC	15000	483	wave
LDR	0.1 - 28000	178	idt
GPS	24000 - 30000	937	xml
LED	72000	10	-
LCD	500000	1634	-
SPDT	120	30	-
PUSH BUTTON	120	34	-

#### IX. LIMITATIONS

During the traverse mode, the device has to be in use for a long period, this will increase the heat of the device, the accuracy of the output value might vary.

#### X. FUTURE WORK

Machine Learning's Descriptive analysis and Prescriptive analysis will be implemented, for the better process of the system, the regular day to day samples will be fed into the device as the samples. A server for connecting number of Smart environmental monitoring system which is installed in major populated cities. The Descriptive analysis of a certain region along with measures to be taken for the better improvement of the region.

## XI. CONCLUSION

This device could help to reduce the pollution factors and also the device could help the United Nations for its 'Sustainable development goals'. the measures for the reduction of the population will help the common civilians to understand the importance of the Environment by visualizing the regular gradation of the factors which affect the Environment.

## XII. ACKNOWLEDGMENT

Hereby Acknowledging the help of Mr. Thillai Rajan N. for working along with us in Interfacing the R Pi and Garmin software and successfully taken the Coordinates.

## XIII. REFERENCE

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