Aim and Purpose:

To design a filter to be placed alongside streets and other high pollution zone to absorb greenhouses gases and pollutants mainly nitrous oxide and carbon dioxide from the atmosphere to reduce the adverse effects of Global Warming. The filter absorbs the following gases.

Carbon Dioxide: Carbon dioxide (CO_2) is a colourless gas which consists of one carbon atom covalently bonded with two oxygen atoms. CO2 is a greenhouse which is the product of aerobic respiration of plants and animals. The current concentration is about 0.04% (410 ppm) by volume, having risen from pre-industrial levels of 280 ppm. CO2 increases the temperature of the planet causing Global Warming. The temperature of the Earth depends on a balance between incoming energy from the Sun and the energy that bounces back into space. Carbon dioxide absorbs heat that would otherwise be lost to space. Some of this energy is re-emitted back to Earth, causing additional heating of the planet. The four Chambers of this filter will contain: 1) Algae; 2) Bases; 3)Activated Carbon, to remove CO2, other Volatile Organic Compounds (VOCs) and odour from the air and send the purified air back to the atmosphere.

Nitrous Oxide: Nitrous Oxide (N_2O) is an oxide of nitrogen and another greenhouse gas and also an ozone destroyer. The base on which the CO_2 filter will made, will be paved with eco paving which will absorb the nitrous oxide from the atmosphere and will convert the nitrous oxide to harmless nitrates which will flow with rain to the soil and will increase the soil fertility.

Places to build the setup: In highly polluted areas like highways, cities, industrial areas, etc, where emission of greenhouse gases like N_2O and CO_2 is the highest.

Theory and Working of the Filters:

The filter works on the basis of absorption of CO_2 by algae, bases like LiOH, NaOH and by activated carbon; and absorption of N_2O by TiO_2 mixed with concrete in the eco paving.

The detailed workings of the parts of the filter are as follows:

Algae Chamber: First algae sample are collected and kept in ideal temperature with right amount of air, water, nutrition and sunlight to allow them to grow. The water in which the algae were cultivated is placed within the algae chamber with transparent walls and an opening to allow sunlight and air to come in respectively. The CO_2 in the air which comes in is utilised by the algae for photosynthesis. The CO_2 is utilised and the end product is oxygen.

Base Chamber (LiOH NaOH or KOH can be used): The air from the algae chamber moves to the next chamber made with polyethylene polymer. The Chamber is filled with LiOH/ KOH/ NaOH solution. These bases react with CO_2 to give metal carbonate solution. The reactions are as follows:

1. $2NaOH(aq) + CO_2(g) \rightarrow Na_2CO_3(aq) + H_2O\ (l)$
2. (1.) $2\ LiOH(s) + 2\ H_2O\ (g) \rightarrow 2\ LiOH{\cdot}H_2O\ (s)$

   (2.) $2\ LiOH{\cdot}H_2O(s) + CO_2\ (g) \rightarrow Li_2CO_3(s) + 3\ H_2O\ (g)$
3. $2KOH\ (aq) + CO_2\ (g) \rightarrow K_2CO_3\ (aq) + H_2O\ (l)$
4. $CaO(s)+CO_2(g)\rightarrow CaCO_3(s)$
5. $CaO(s)+H_2O(g)\rightarrow Ca(OH)_2(aq)$

After a while the solution gets saturated and so at night when the shutters are closed the saturated solution is transferred to storage where they can be treated to give out CO_2 for various uses. The alkali can be attained again which is sent back to the chamber. The following reaction takes place:

1) $Na_2CO_3(aq) + Ca(OH)_2(s) \rightarrow 2NaOH(aq) + CaCO_3(s)$

   $CaCO_3(s) \rightarrow CaO(s) + CO_2\ (g)$

2) K_2CO_3 (aq) + $Ca(OH)_2$(s) → 2 KOH (aq) + $CaCO_3$(s)

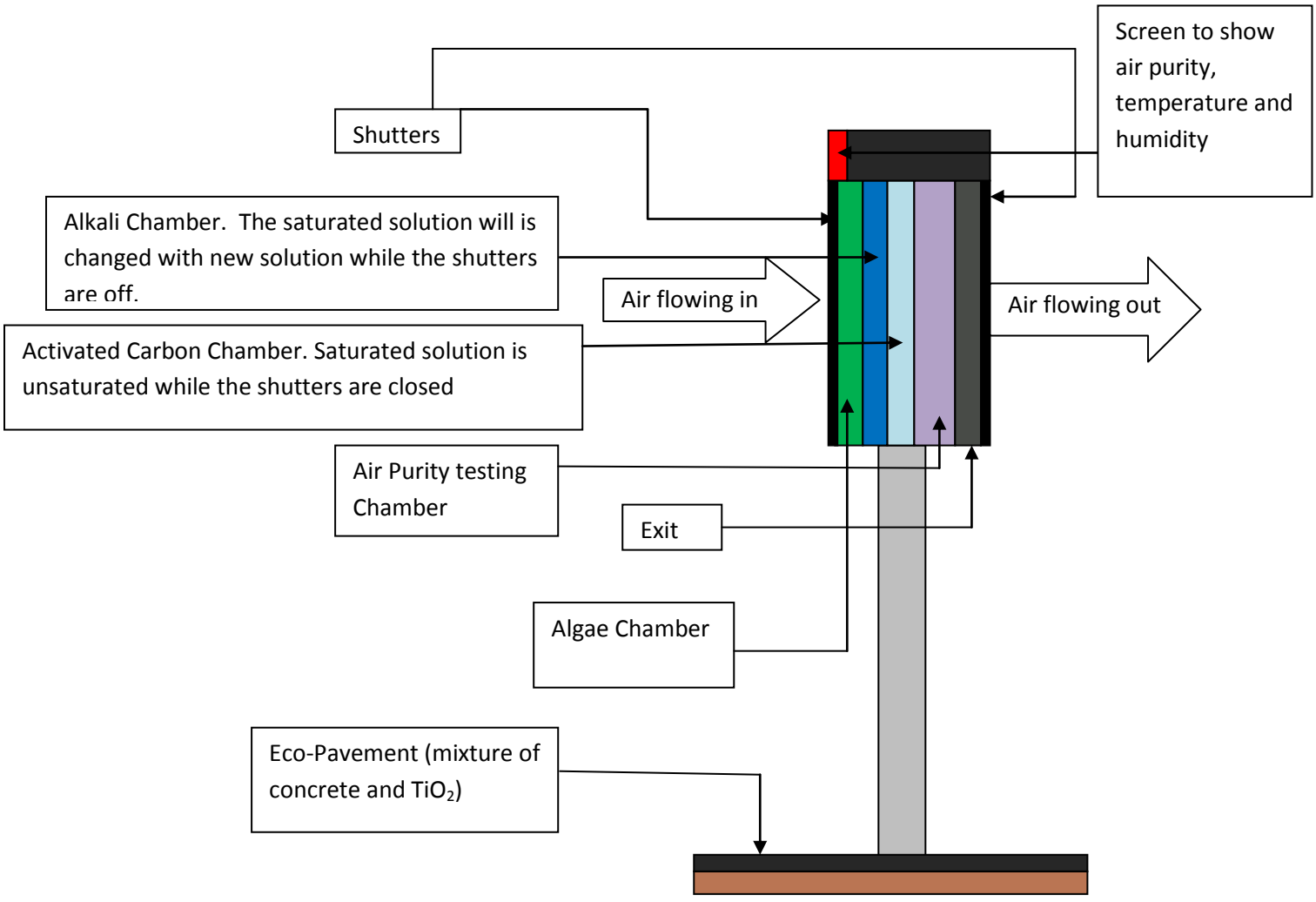
$CaCO_3$(s) → CaO(s) + CO_2 (g)

Activated Carbon Chamber: The air is then sent to the third chamber filled with bed of activated carbon. It absorbs CO_2 along with other VOCs and pollutants to purify the air. Once the bed is saturated it must then be regenerated by blowing low carbon dioxide air, such as ambient air, through the bed. This will release the carbon dioxide from the bed, which can be stored for future use.

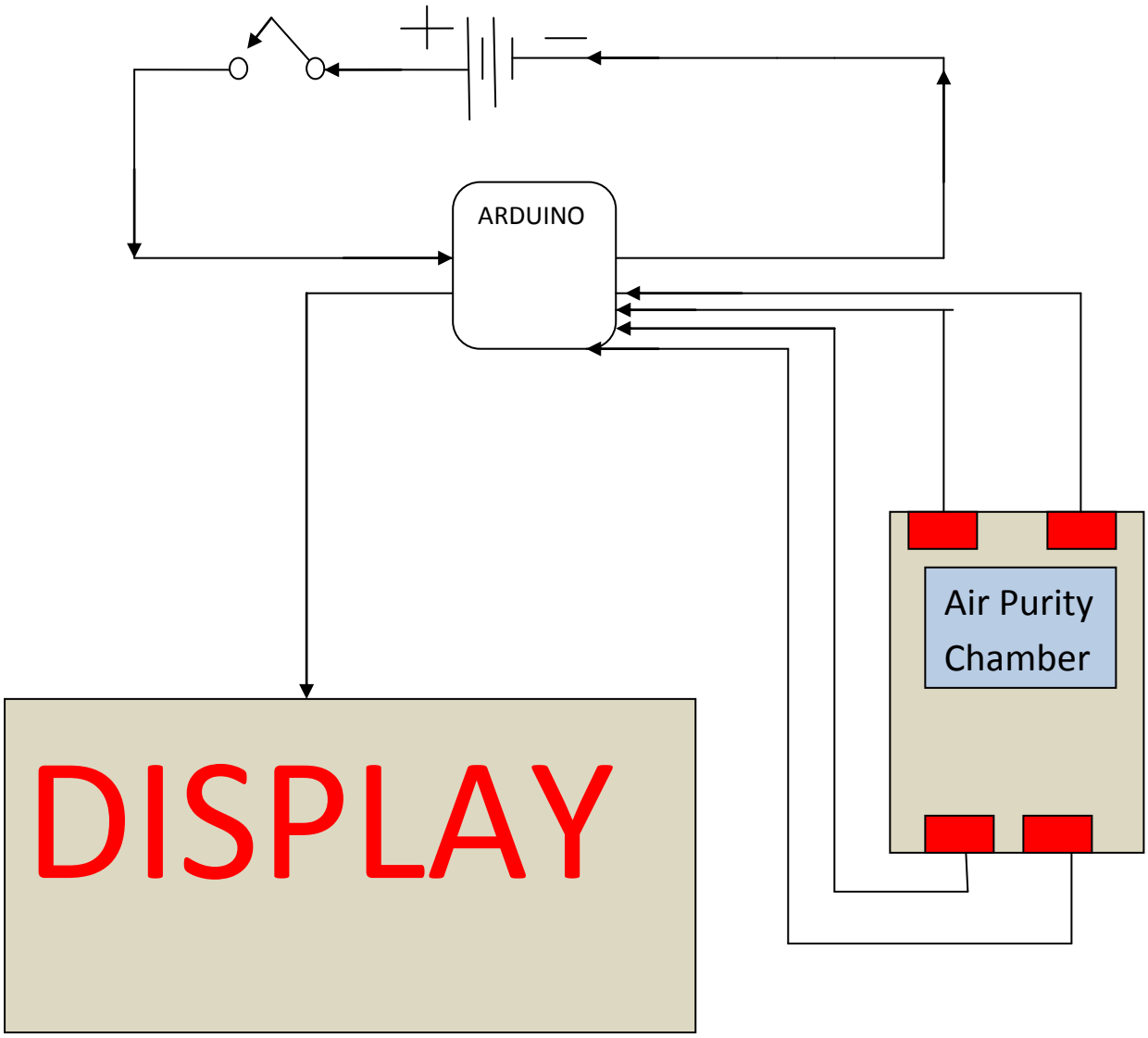
Sensors: The last chamber will contain air sensors to show the quality of the air, amount of CO, N_2O, CO_2 in the air, amount of particulate in air, temperature and humidity through a LCD Display.

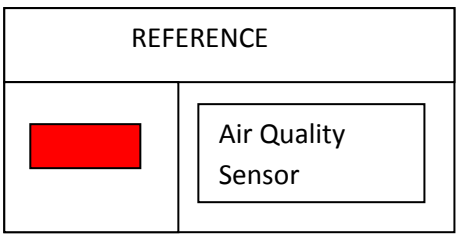
Eco Paving: The ground, where this filter will made, will be paved with eco-paving which is a paving made with the mixture of concrete and TiO_2, TiO_2 will absorb the nitrous oxide from the atmosphere and with the help of sunlight it will convert the nitrous oxide to harmless nitrates which will flow with rain to the soil and will increase the soil fertility.

Blue Print of the Filter:

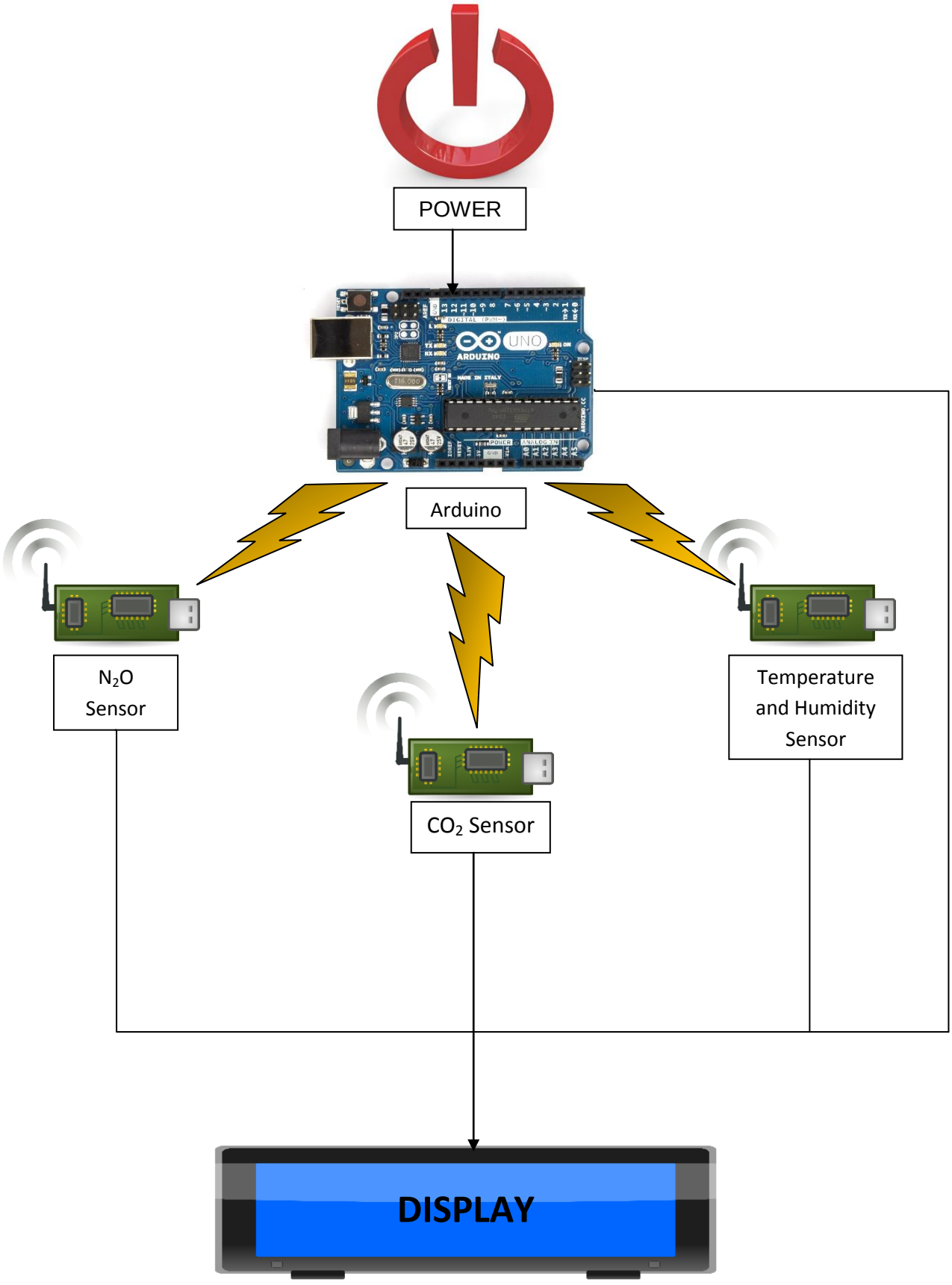


Circuit Diagram of the Filter:





Application:



The main electric supply is connected to all the sensors and the main receiving sensor board. These sensors are individually connected to the Arduino board which receives signal data and forwards to the main LCD display. Arduino is programmed to convert the sensor signals to numbers, the programming also includes colour based display with varying ranges received from the sensors

Feasibility and Overall Impact

- Trying to ignite a feeling of responsibility towards our planet
- Reducing the global warming by absorbing the greenhouse gases.
- Trying to put a balance in the environment as all things should be.
- We tried our level best to make our project cost efficient and applicable everywhere.

Overall Impact:

1) Increased air purity: The filters will absorb harmful gases like excess CO_2 increasing the air purity.
2) Reduction of Global Warming: Decrease in greenhouse gases will also decrease the global warming issue faced by the world.
3) Helps people with breathing disability: Increase in air purity will also help people suffering from breathing problems like asthma.

COST ANALYSIS

SL. no.	Item	Quantity	Cost per unit(in Rs.)	Total cost (in Rs.)
1	NDIR CO2 Sensor MH-Z14A PWM	1	1,660	1,660
2	Nitrous Oxide Sensor	1	51,400	51,400
3	DHT11 – Temperature and Humidity Sensor	1	120	120
4	Arduino UNO R3	1	500	500
5	Breadboard	2	100	200
6	Lithium Hydroxide	1(in kg)	1,650(per kg)	1,650
7	Activated Carbon	1(in kg)	400(per 250 g)	1,600
8	Titanium dioxide	1(in kg)	600(per 250 g)	2,400
9	LCD Screen	1	600	600
10	Wires(1.5 mm)	1(in kg)	648	648
			Total cost of the project:	60,778

REFERENCES

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- https://en.wikipedia.org/wiki/Lithium_hydroxide
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