

Water Filter Project Interim Report



By

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Introduction

The aim of this assignment is to design and build a project that can provide a low-cost solution that is simple to manufacture to one of three given topics with realistic problems while demonstrating the ability to assess the quality of the work in terms of efficiency and reliability. This project is based around a microcontroller, namely the Arduino microcontroller.

The three given topics to choose from for the project are as follows;

- Design a STEM (science, technology, engineering, and mathematics) project for school children in developing countries. The project must be easy to medium difficulty and include step by step instructions. This project is set to encourage and promote STEM in an engaging way, aim to make the project as fun and interactive as possible.
- Design a product that is aimed at helping people to be more eco-friendly at home. This could include making people more aware to help limit the amount of water, food, or electricity wastage in the household.
- Design a low-cost assistive device to help people with an impairment or disability. The device should be aimed at improving the quality of everyday life of the individual.

After a lot of discussion into the three topics, we decided that we would go with a project specialising STEM as we found the topic the most beneficial and interesting.

Research into Chosen Topic

The first task before designing the project was to choose which of the three topics to build the project around. When given the assignment brief, research was conducted into what kind of projects can be built with an Arduino within each of the given topics. Below are some examples of possible project ideas:

STEM research:

- Water filter (IJWEbbers, n.d.)
- Smart watch (Joseph, 2023)
- Alarm Clock (Guitarman9119, n.d.)

Eco-friendly research:

- Water quality monitoring system (RowlesGroupResearch, n.d.)
- Air quality monitoring system (ARDUINO TEAM, 2022)
- Metal Detector (TechKiwiGadgets, n.d.)

Disability assistive device research:

- Door mounted room name sensor – Idea from Steffan Weaver
- Brail box (Mukesh_Sankhla, n.d.)
- Smart walking stick (avlokam, n.d.)

Choosing a Project Idea

After researching ideas, the project that was decided was a water purifier system that uses a combination of natural resources and UV light to filter out and eliminate over 99% of bacteria, making water safe to drink. This project idea was inspired by other products such as a water quality monitoring system, which monitors different things in water such as ph. levels or turbidity, and also the LARQ water bottle, which is a self-cleaning water bottle that uses UV light to clean itself (LARQ, n.d.).

Water Purifier Research

Below are some of the areas that were explored when researching the design of the water purifier and how it would function, along with the team member who researched which areas:

UV purification – Scott

In order to purify water using UV light, the UV LED must be UV-C with a wavelength of 254nm (Reed, 2010), and must have a minimum strength of $30\text{mJ}/\text{cm}^2$ (Uta, 2022).

Water quality monitoring – Ethan

There are many factors that come in to measuring the quality of water and the safety of it, including pH, temperature, turbidity, and more (N. A. Razman, 2022). The aim of the project is to measure the turbidity of the water as an indicator of whether the water is clean or not. Turbidity can be described as “the measure of relative clarity of a liquid. It is an optical characteristic of water and is a measurement of the amount of light that is scattered by material in the water when a light is shined through the water sample,” (Water Science School, 2018).

Particle filtration – Steff

The filter that will be used in order to remove particles will be a handmade sand, charcoal and cheese cloth filter. The filter will be made up of an inch of sand followed by an inch of charcoal and another inch of sand. All this will be wrapped in a cheese cloth. (Michaud, n.d.)

Arduino powering – Tommy

The aim is to make the filter portable so it will need a portable power supply and a 9v battery has been chosen to power the Arduino. To do this “You can simply connect the + end of your battery to Arduino Vin and the - end to Arduino ground” (amandaghassaei, n.d.)

Team Organisation

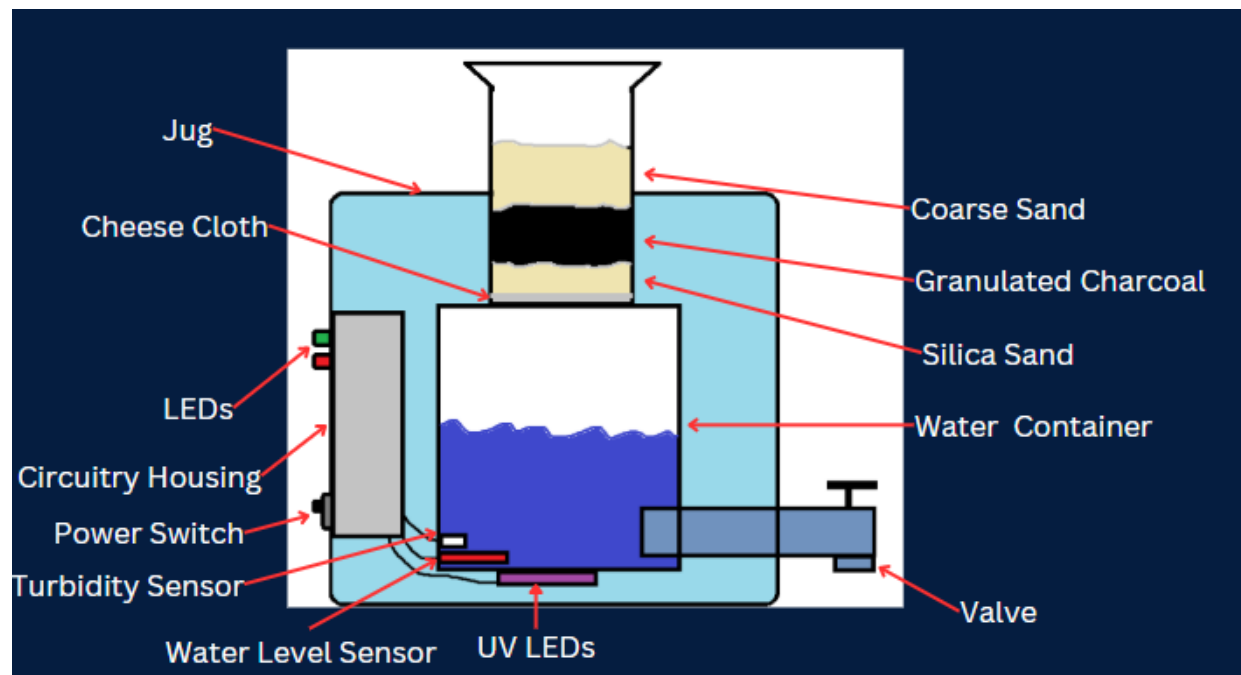
For this project the roles and responsibilities will be allocated to different people. These roles only show who will be responsible for an area of the project being completed not that they will be the only person to work on that area.

The roles are as follows:

Role	Person allocated
Coding	Steffan Weaver
Sourcing parts	Scott Tavner
Breadboarding	Ethan Byrne
CAD Design	Tommy Rosser
PCB Design	Scott Tavner

Project Plan

Labelled diagram:

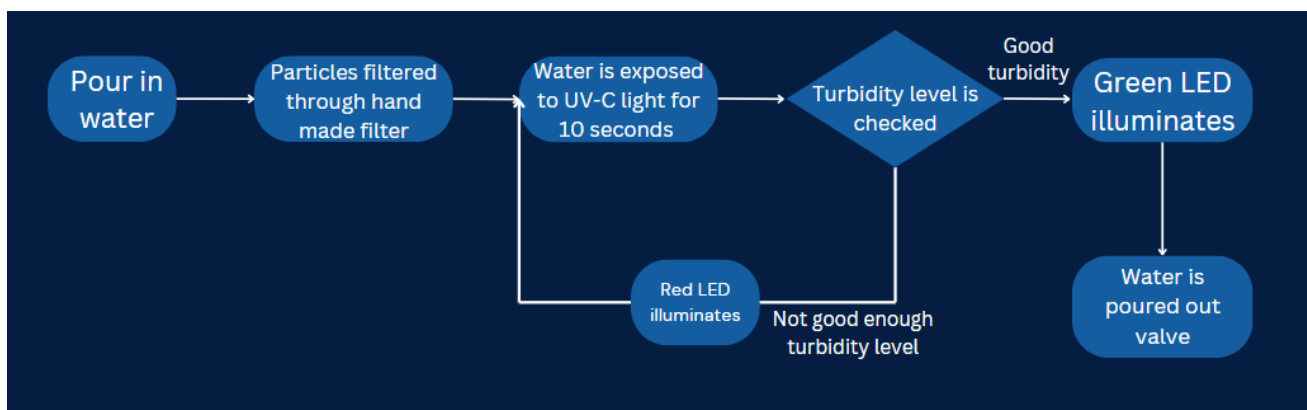


The labelled diagram above shows the area where the parts we buy will fit into our design. This is a rough diagram of our end design. The final design will look more aesthetically pleasing and more functional for transporting. The top half of the diagram shows the changeable water filter that is made of coarse sand, granulated charcoal and silica sand, all held within a cheese cloth to allow water to pass through. Below the water filter is the water tank that collects the filtered water and uses the UV-C LEDs to purify the water of any microscopic bacteria that would make the water dirty. Final, to the left of the water tank is the circuitry housing that holds all the electronics so that they are concealed and don't get wet from the water.

How it Works

For the design we want the following steps to take place when using our product;

1. User pours the water into the top of the jug.
2. The water is filtered through the changeable water filter and through to the water tank
3. The filtered water is exposed to UV-C light for 10 seconds.
4. The turbidity sensor will check the water after the 10 seconds to see if it's clean.
5. If the turbidity sensor thinks the water isn't clean enough the red light will turn on showing the user, the water is not safe to drink and the water will go through another cycle of UV-C light.
6. If the turbidity sensor thinks the water is clean enough, then a green light will turn on showing the water is safe to drink.
7. The user can then pour the water out using the valve.



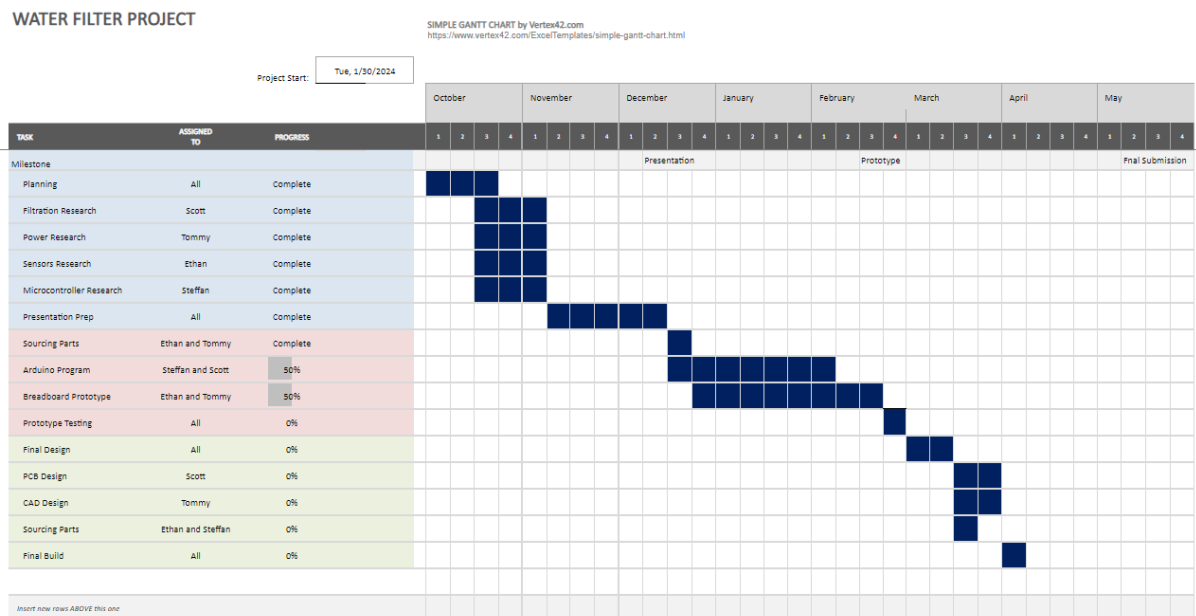
Bill of Materials

Below is a table for the bill of materials that shows the components that are required to build the project and the cost of them:

Item	cost (£)	quantity	total (£)		
UV LED	6.13	3	18.39		
Water level sensor	6.99	2	13.98		
Turbidity sensor	9.5	2	19		
Green led	0.199	3	0.597		
red led	0.362	3	1.086		
2K2 resistor	0.11	3	0.33		
10R resistor	0.09	3	0.27		
220R resistor	0.169	6	1.014		
Silica Sand	2.56	1	2.56		
Granulated Charcoal	4.99	1	4.99		
Cheese cloth	2.89	1	2.89		
arduino Uno	15.84	1	15.84		
Jug	15.99	1	15.99		
2N2222 NPN Transistor	0.11	3	0.33		Total cost of every item (£)
					96.337

Progress

A Gantt Chart was created at the beginning of the year to keep track of the progress of the project and to give a general idea of when certain stages of the project should aim to be completed by. The application used to create the Gantt Chart was Microsoft Excel. The diagram below displays the group's Gantt Chart:



November

November has gone mostly to plan however we spent week 2 doing research as well as delaying our presentation prep by a week and starting it in week 3 however progress on it is coming along quicker than expected so this should not be a problem.

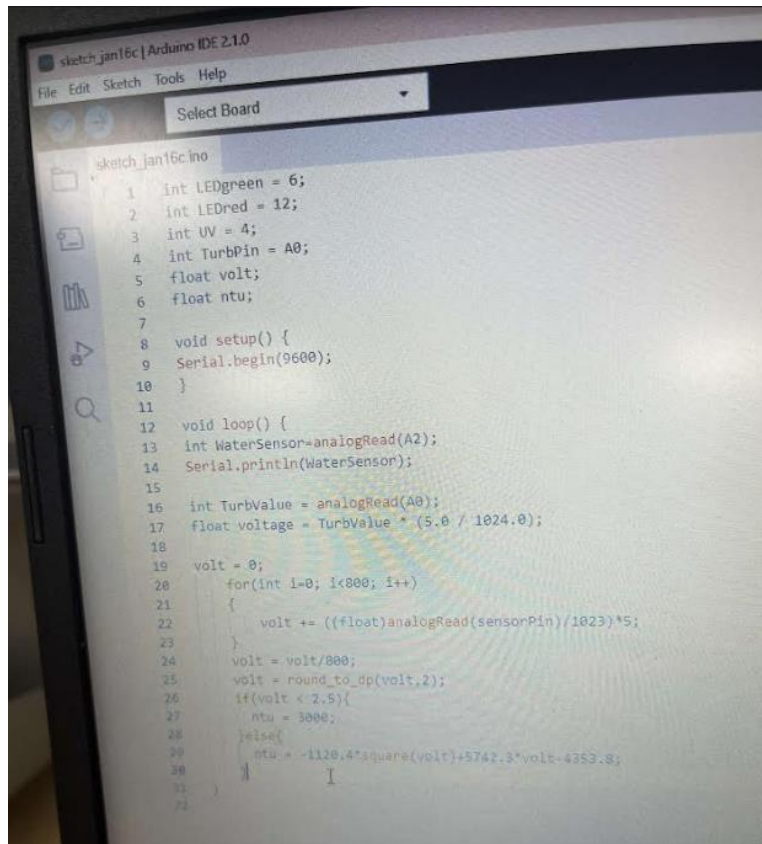
December

Our presentation has been complete on time when compared to the Gantt chart and was ready to be presented however the presentation has been delayed to the second week of January after the Christmas holidays. We have also managed to make an order form too get the pieces we need in order to start prototyping.

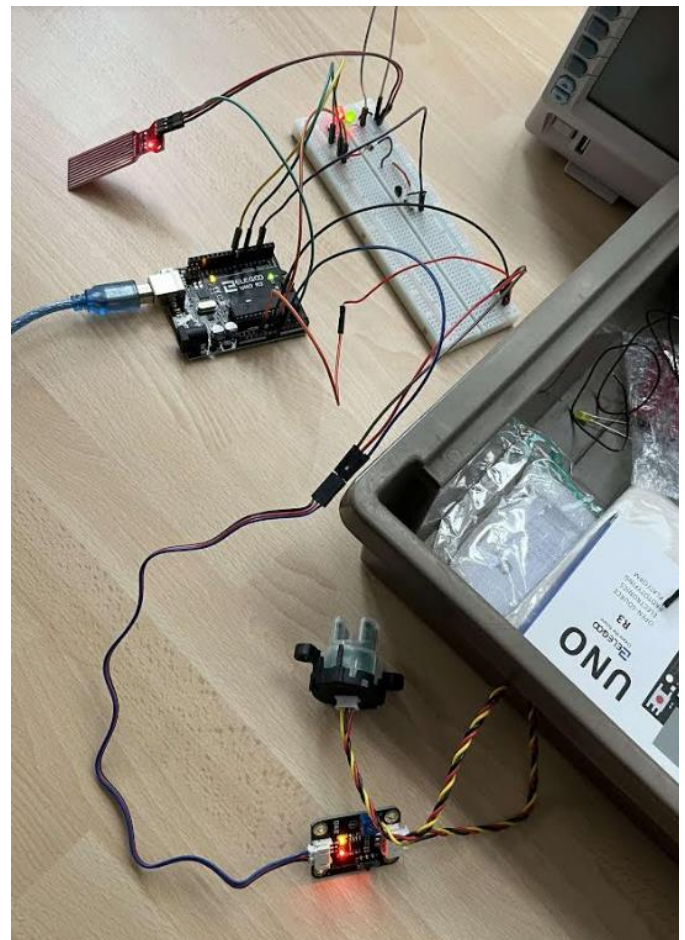
January

The presentation has been completed in week 2 and the parts for prototyping have arrived so a breadboard prototype and accompanying code has been started. as of looking at the Gantt chart we are on track to have a working prototype at the end of February. Current issues we are facing are powering the board externally as some LEDs are turning off with a 9V supply as well as the UVC LED being challenging to connect to the breadboard due to its surface mount soldering design.

Progress images:



```
sketch_jan16c.ino
1  int LEDgreen = 6;
2  int LEDred = 12;
3  int UV = 4;
4  int TurbPin = A0;
5  float volt;
6  float ntu;
7
8  void setup() {
9    Serial.begin(9600);
10 }
11
12 void loop() {
13   int WaterSensor = analogRead(A2);
14   Serial.println(WaterSensor);
15
16   int TurbValue = analogRead(A0);
17   float voltage = TurbValue * (5.0 / 1024.0);
18
19   volt = 0;
20   for(int i=0; i<800; i++)
21   {
22     volt += ((float)analogRead(sensorPin)/1023)*5;
23   }
24   volt = volt/800;
25   volt = round_to_dp(volt,2);
26   if(volt < 2.5){
27     ntu = 3000;
28   }else{
29     ntu = -1120.4*sqare(volt)+5742.3*volt-4353.8;
30   }
31 }
32
```





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