Rain Water Harvest

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***Abstract*—In our regular life we face so many problems related to our natural elements. Among them during heavy rain we face difficulties. Like, in some places rainwater becomes a massive issue to move here and there, because many of the places drown. To solve this issue, we implement this project so that we can use rainwater as a useful component. We divided our project into three parts - collection, purification and distribution. Basically, our motive is to supply the rain water in various sources and to reduce the issue of flooding and make the lifestyle easy during heavy rain. Moreover, the whole project is based on so many components, such as Arduino, STUD Reflector, CNB1 water pump. These electrical components are carrying a huge portion of work in this project. Overall, we hope that this project will bring us benefit to toggle with the problems and getting advantage from that.**

***Index Terms*—Arduino, STUD Reflector, Water Purification**

I. Introduction

One of the major problems in any third world country is flood. Every year, flood causes a lot of damage including loss of life, damage to crops, loss of drinking water treatment and water supply, which causes severe water contamination. It also causes sewage disposal problems. Bangladesh, is especially prone to flooding due to various reasons that include 70 percent of its land being less than 1 meter above sea level, heavy monsoon rainfall and most of the country consisting of a huge flood plain and delta. In urban areas like Chittagong, flood not only causes difficulty in commutation, but also spreads a lot of diseases as the flooded water mixes with the sewage under the roads.

This project mainly targets the Urban areas of a country where excessive amounts of rainfall causes roads to flood.This project implementation will not only solve this problem but the rain water can also be harvested to help tackle the loss of water supply caused by the floods. This project has a multipurpose of collecting the rainwater, its purification and its distribution.

II. Project Overview

A. Features at a glance

1) Collection: A STUD reflector will be modified with a Rain sensor and Centrifugal pump and placed on the roads. When it rains, the system will automatically collect the rain water and pipe it into a tank for purification.

2) Purification: The water will go through several stages of purification that will make it safe for cooking and drinking purposes. These stages are:

- The water will first undergo basic filtration through a mesh that will remove large particles.
- It will then be left still in order for the insoluble particles to settle at the bottom.
- The water will be oxygenated in order to prevent it from going anaerobic.
- . Floating particles will be pumped out from the top.
- The water will be passed through a viqua water purifier which will filter off extremely tiny particles and use a strong UV ray to kill bacteria and viruses.

3) Distribution: After collecting the rainwater we can distribute it among the 2 points below :

- We can directly send excess Rainwater after collecting it from the STUD reflector to the groundwater level of the earth by using the Gravity System Water Distribution. We can always monitor our Harvested Rainwater by keeping data on the database. By using the touch pad we can verify and then keep control of the distribution.
- After collecting the Rainwater from the STUD reflector we will purify with our purification elements and make Drinkable water. As our Tanks might be on the ground level we will use the pump system distribution .

B. Component List

1) Rain Sensor
2) Arduino
3) CNB1 Series Pump
4) Modified STUD Reflector
5) Pipes
6) Water tanks
7) 1mm Mesh
8) Calmed Inlet
9) Viqua Water Purifier
10) Database and Monitor

C. Flow Chart

Flow Chart is shown in Fig. 1

III. Component Description

A. Rain Sensor

The Rain Water Sensor is a simple sensor and an easy to use tool for detecting rain. It acts as a simple switch, where the switch is open when it is dry and when it rains, the switch closes.

Without the presence of water, the resistance between the contacts is very high. When rain falls on the board, it creates a parallel resistance path which reduces the overall resistance. This sensor shows resistance based on the moisture i.e. it

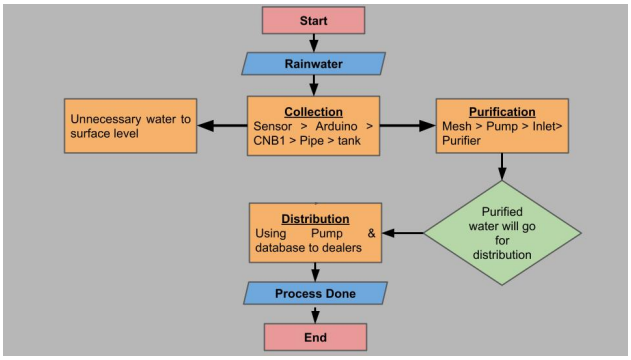

Fig. 1: Flow Chart

shows more resistance when it is dry and shows less resistance when it is wet.

[Image of Rain Sensor in Fig. 2]

Fig. 2: Rain Sensor

B. Arduino

An arduino is an electronics tool that can perform logical computations which makes it very easy to do complex actions. It has a printed circuit board on which, there is an integrated circuit and pin headers that allow us to connect to the integrated circuit. An integrated circuit is basically a tiny computer that can perform some kind of program. This program can be loaded up after being coded on the Arduino IDE. It also has a barrel jack that can be used to power it and a USB port that allows it to be very easily connected to a computer.

[Image of Arduino in Fig. 3]

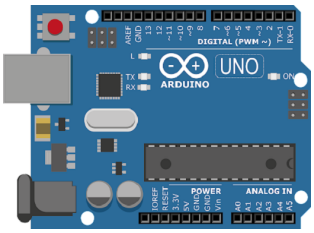

Fig. 3: Arduino

C. CNB1 Series Pump

A CNB1 pump is an induction motor that turns a shaft, which, in turns, rotates an impeller. An induction motor rotates with the help of a magnetic field generated around a squirrel cage like rotor. Alternating Current is passed through three coils each 120 degrees from each other, causing a rotating magnetic field (RMF) to form. This induces electricity into the rotor and therefore, this current carrying rotor situated inside a magnetic field will experience an electromagnetic force (according to Lorentz force law), causing it to rotate.

This pump has an impeller, which is a series of curved vanes. It is submerged in water so, when it rotates, the water around it rotates as well. This imparts centrifugal force to water particles and the water moves radially out. Here, rotational mechanical energy is transferred to the fluid and discharged to the sides of the impeller both pressure and kinetic energy for water to rise. At suction side water gets displaced and negative pressures will be induced to the eye. Such a low pressure helps in sucking fresh water stream and this is how the process will continue collecting water. Using this system, fluid can be transferred from one place to another.

Since, we are working with water, which is not very viscous; we will need a closed impeller because it is used for low viscous fluid.

[Image of CNB1 Series Pump in Fig. 4 Impeller in Fig. 5]

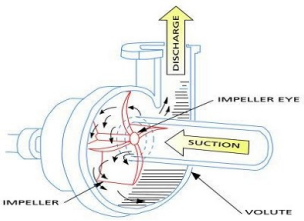

Fig. 4: CNB1 Series Pump

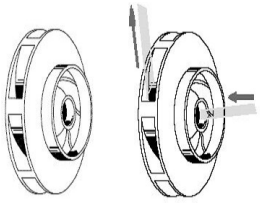

Fig. 5: Closed Impeller

D. STUD Reflector

A Stud Reflector is a Reflective Road Marker. These include a reflective sheet or lens that reflects the light from headlights of vehicles and make the road visible to the drivers. They are anchored to the road surface for delineation and lane marking for night-time visibility. These are especially useful where there are no streetlights. Typically, these are made from Aluminum which makes them durable enough to not be crushed when a car drives over them.

[Image of STUD Reflector in Fig. 6]

Fig. 6: STUD Reflector

E. Pipes

There will be pipes to transfer the water from the pumps to the tanks for further processing.

[Image of Pipes in Fig. 7]

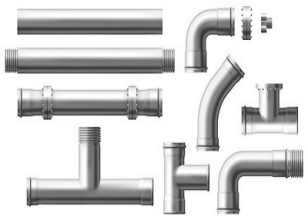

Fig. 7: Pipes

F. Water Tanks

For storing the water we need water tanks. From the water tank the water will be purified and supplied to the users.

[Image of Water Tank in Fig. 8]

Fig. 8: Water Tank

G. Mesh

A mesh is a material with evenly spaced holes that allows particles smaller than the holes to pass while catching the ones that are larger than the holes. For this project, a stainless steel mesh is best and, ideally, at this stage we should be looking to filter the water to at least 1mm - the finer the better.

[Image of Mesh in Fig. 9]

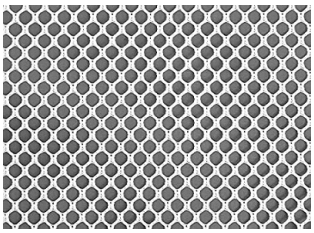

Fig. 9: A picture of a Mesh

H. Calmed Inlet

A calmed inlet is a U footed bend that directs incoming water upwards, away from any sediment that has settled at the bottom of the tank. This way incoming water does not disturb the sediment, preventing it from dissolving and contaminating the rest of the tank water.

[Image of Calmed Inlet in Fig. 10]

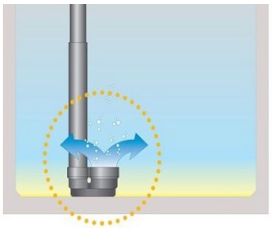

Fig. 10: Calmed Inlet setup

I. Viqua Water Purifier

A viqua water purifier uses UV light to purify water. The germicidal energy of the UV light attacks the DNA of harmful microorganisms, eliminating their ability to reproduce. The UV light is generated using a UV lamp that has an inert gas mixed with mercury inside of a quartz glass cylinder. When electricity is passed through it, the mercury reacts with the electricity, producing UV light. This lamp is placed inside of a stainless steel cylinder through which water passes. This causes the light to go through the water and purify it. However, in order for the light to properly purify the water, it has to be able go through all the water. So, there cannot be anything that can block the light. Hence, it has to be ensured that the water is crystal clear before it passes through the stainless steel cylinder. This is done by passing the water through a sediment filter before it enters the stainless steel cylinder. The water also passes through a carbon filter to improve its taste.

[Image of Viqua Water Purifier in Fig. 11]

Fig. 11: A picture of a Viqua Water Purifier

J. Database and monitor

A database will be used to store information about the amount of rainfall different places receive in order to further improve the project. By installing more frequent STUD reflectors in places that receive high rainfall, we can ensure that those places are drained of rainwater faster. At the same time, by placing STUD reflector less frequently in places that receive little rainfall, we can reduce power usage. We can view these data using a monitor or a screen of some sort.

IV. Project Setup

A. Collection Process

In this project, we will modify a STUD reflector and use it in conjunction with a rain sensor, an arduino and a centrifugal

pump to collect rain water. The reflector will have holes drilled into it that will allow water to get in. Inside, there will be a rain sensor that will send a signal to an arduino upon detecting rain. The arduino will be programmed to turn on a centrifugal pump connected to it. This way, whenever it rains, the system will automatically draw rainwater away from the roads to a tank, and thus prevent flooding. Since STUD Reflectors are usually made durable in order to prevent them from being crushed by vehicles passing over, placing the fragile components like the rain sensor, arduino and the centrifugal pump inside the STUD Reflectors will protect them as well.

B. Purification Process

Before the water enters the tank, it will go through a mesh that filters off large debris and leaves that are collected alongside the water. Then, the water will be left still for smaller particles that are insoluble and heavier than water to collect at the bottom, and the ones that are lighter than water to float up. The floating particles will then be pumped out. Rain water can develop a bad smell if it is left still. In order to avoid that, the water will be oxygenated. This will be done using a centrifugal pump which will propel the water out of the tank and into a funnel where the water comes in contact with air. The water then enters back into the tank through a calmed inlet in order to prevent any sediment collected at the bottom to dissolve back into the water. To get a better idea about the layout of the tank, take a look at figure 12.

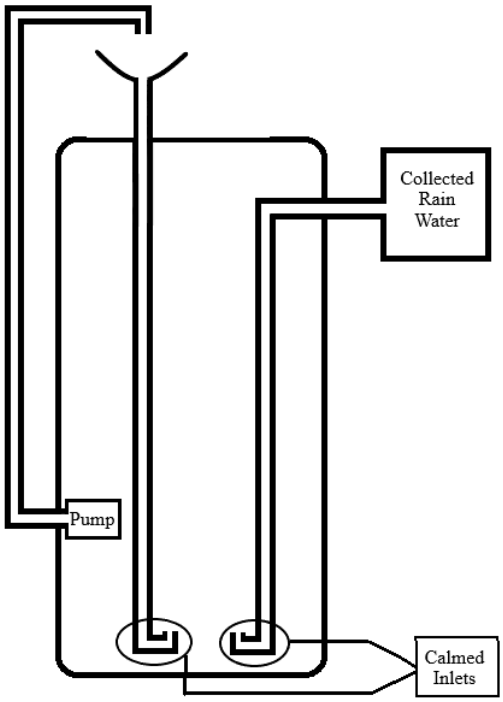

Fig. 12: Tank Layout

C. Distribution Process

In case of unexpectedly large amount of rainfall that might happen due to natural calamities like a cyclones, the amount of water collected could be too much for our purification process to keep up with. In such cases, the excess water will be transferred underground to be a part of ground water. This will be done using the gravitational potential energy of the water without the use of any pump. To better understand this process, see figure 13. The remaining water will go through the purification process, after which, it will be sold in a first come first serve manner.

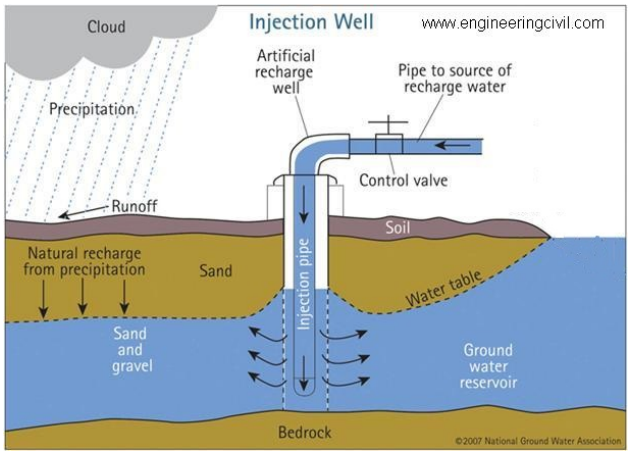

Fig. 13: Excess water injected underground

V. Individual contribution

In this project, I did the research for how the project will execute and which components are needed. From the components I focused on the Arduino and Modified STUD Reflector(Rain sensor and CNB1 series pump). On the other hand, the collection of rainwater part is described by me. However I also contribute to how the other segments will work for the project. I did the diagram of the purification process in the ”Project Setup” section. I showed the entire process in flowchart so that it makes sense to others how the implementation will be done and particularly which component will be used for the collection, purification and distribution part. I hope my performance for this project will be easy to understand.

VI. Challenges of the project

Our project, ”Rain Water Harvesting”, had a lot of really challenging aspects to it. We had a good idea about how we would handle the collection and the purification processes but we struggled to figure out how to handle the distribution process in a way that would be the most useful. Moreover, figuring out which components would be the most effective and collaborating them in order to make them work smoothly required quite a lot of brainstorming. However, these challenging aspects taught us a great deal about how to efficiently handle these kinds of problems.