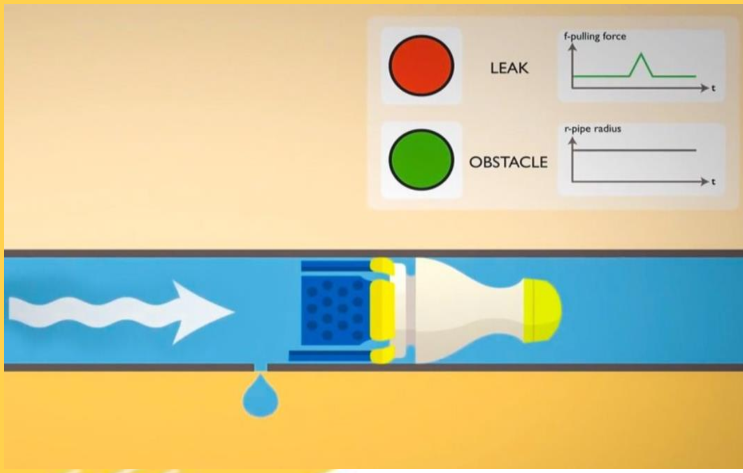
CIVIL ENGINEEING DEPARTMENT

C-HELIX

# PIPE LEAKAGE DETECTION SYSTEM

## Constructed By- Raghav and Shubham Agarwal




## ABSTRACT:

Underneath the streets in every city around the world, water pipe systems distribute this precious resource quietly and their important problems are usually unnoticed. On such problem is pipe leakage. It has been reported that around 20 % of the clean water supply in almost all countries around the globe is lost due to leaks. water leaks are difficult to find. But in -pipe leak detection methods with cameras, acoustic system and pressure sensing system can find the location of those leaks more reliably and accurately.

## OBJECTIVES:

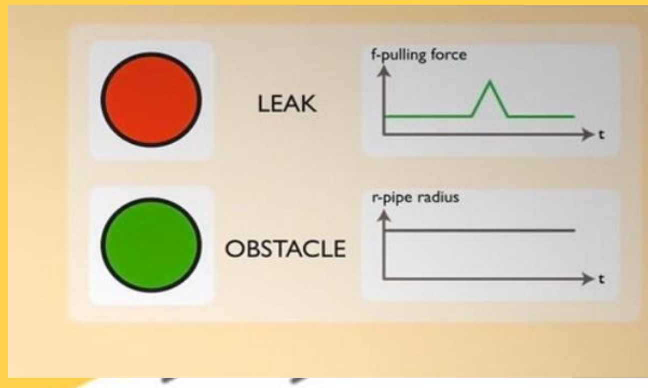
It has been reported that around 20 % of the clean water supply in almost all countries around the globe is lost due to leaks. water leaks are difficult to find.But in the Pipe Leakage System, there is the Leak Detection Robot which is capable of finding leaks in city water pipes more reliably and accurately.

### ABOUT THE PROJECT:

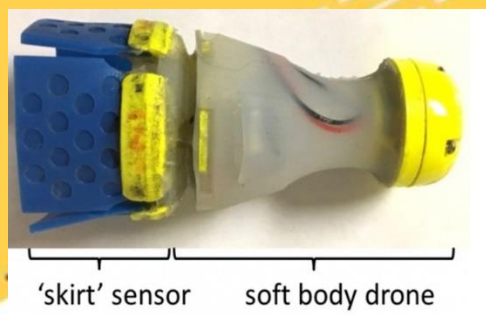
This is the Leak Detection Robot. It can find leaks in city water pipes. It has three components. The blue membrane sensor can be stretched and sense a pulling force. The yellow flexible support can be compressed and measure the pipe size change. The Robot housing contains electronics to make the robot wireless. The housing is made of soft rubber so it can bend to go around pipe elbows.

## WORKING:

- Technician arrives at job site, puts the robot into the underground water pipes through customised robot launcher.
- In a leak, water is escaping from a pipe and creates a suction of force. When the robot passes a leak the blue membrane sensor will feel the suction force and get stretched.




The robot senses this stretch and indicates a leak. Now one may ask, how about false alarms? The robot can distinguish obstacles from leaks. In a pipe, obstacles can be dirt, scales, or other kinds of pipe diameter reductions. When the robot passes an obstacle the yellow support will be compressed, combining the compression signal and the stretch signal. The robot can differentiate leaks and obstacles.
- Along its path and generates Google Map where we can see respective signals to leaks and obstacles.



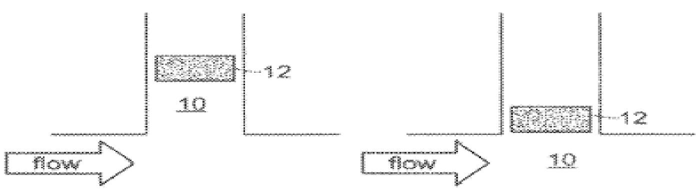




FIG. 1

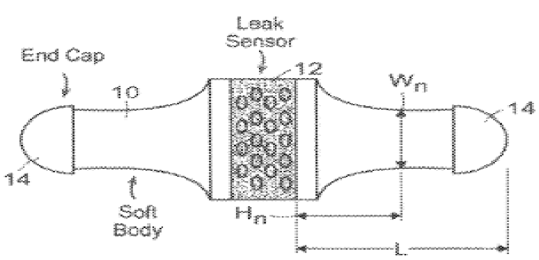



FIG. 2A

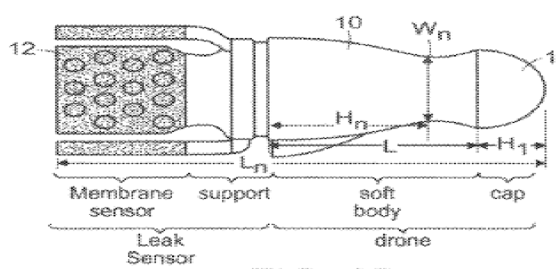
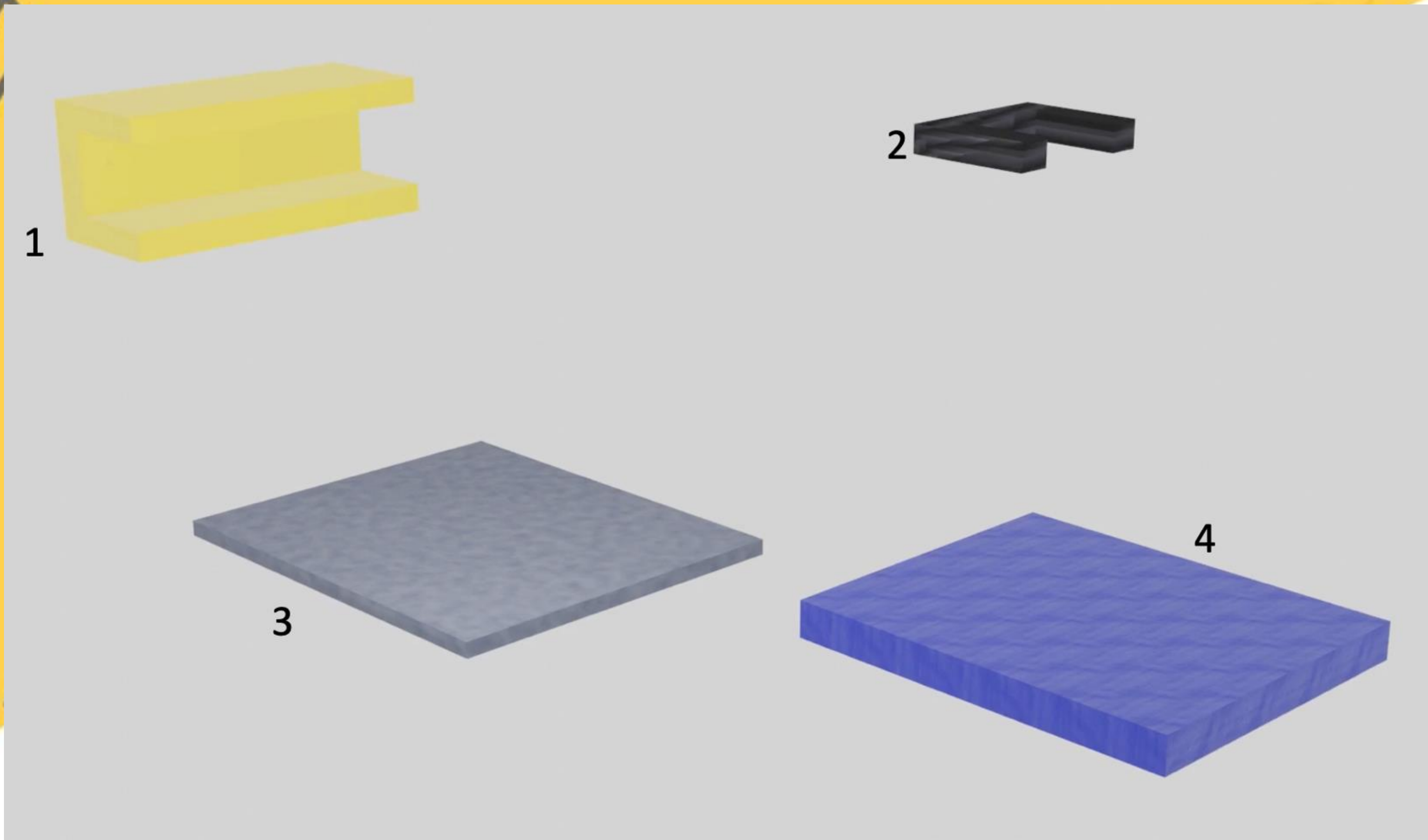


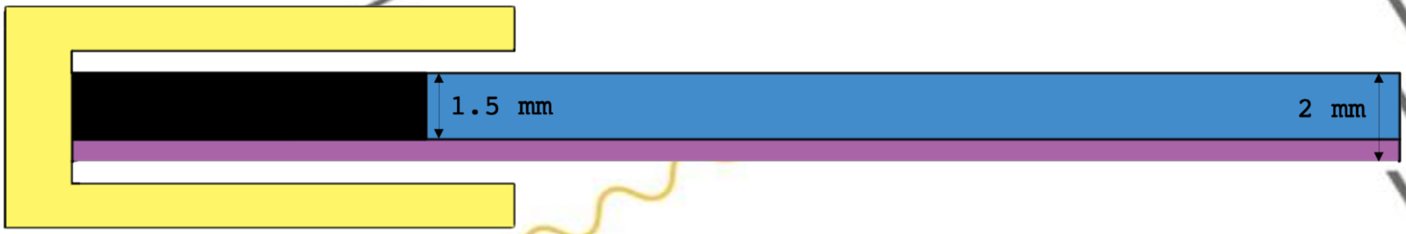

FIG. 2B

## A Note on the Sensor:

- First, let us label the different parts of the sensor:
- 1. Plastic Bracket
- 2. Conductive Rubber



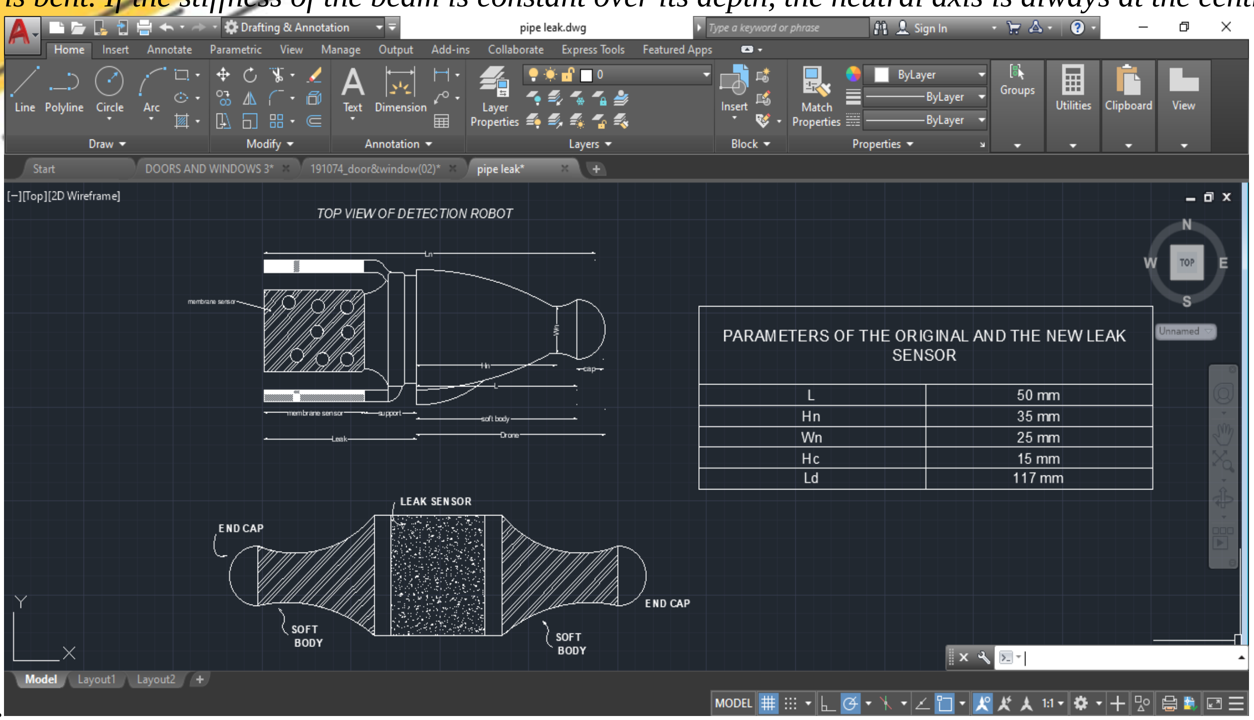

- 3. Fabric
- 4. Non-conductive Rubber

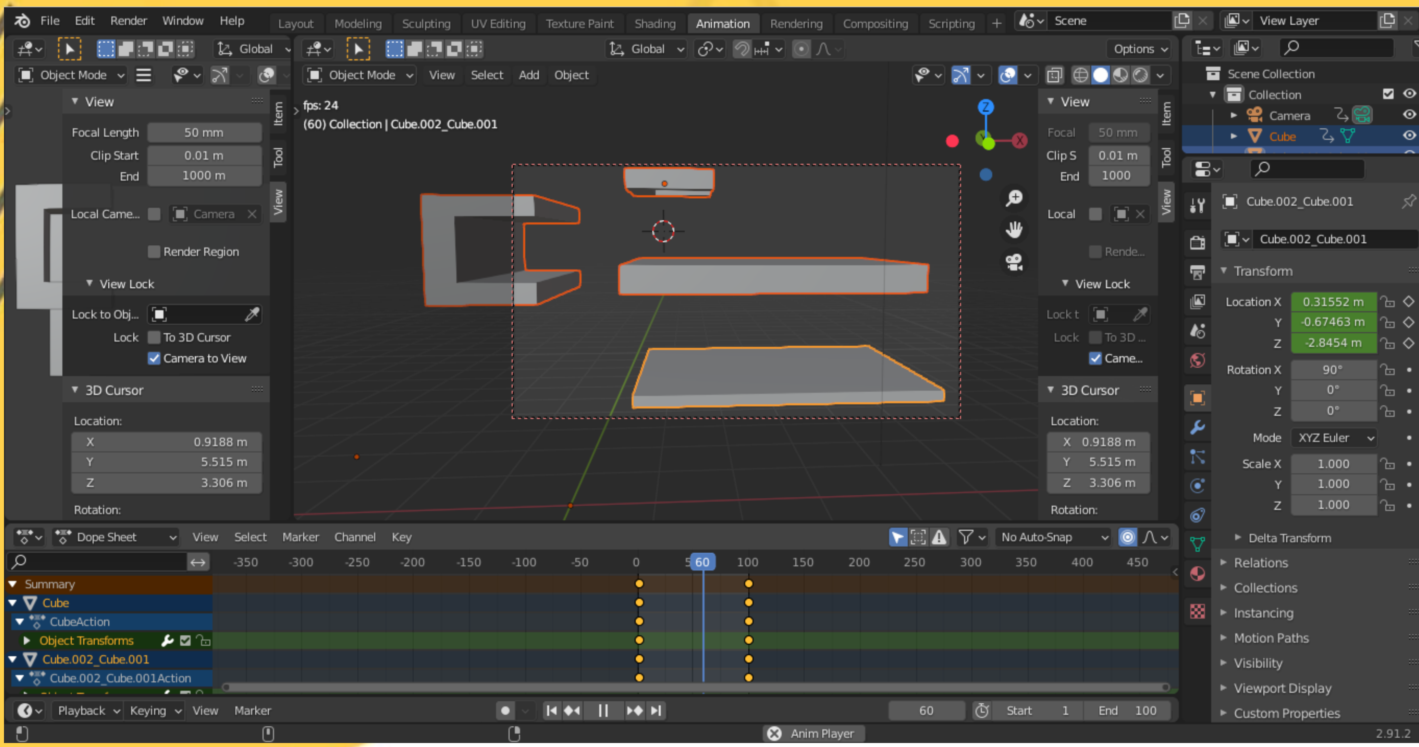


## Functioning:

- The black part of the sensor has a special property wherein its electrical resistance decreases when it is compressed and increases when it is stretched or expanded. This rubber comes in sheets of thickness no less than 1.5 mm.
- The way this sensor works is that as it detects a leak or debris, it is either stretched outwards due to suction or bent inwards. As it does so, the change in resistance of the conductive rubber detects the presence of leaks or debris in the pipe.
- Now, for this to work, the black rubber piece has to be placed either above or below the neutral axis* of the whole sensor. Because then only the conductive rubber will either be under expansion or compression. If we put the conductive rubber on the neutral axis*, we shall not be able to obtain conclusive results.
- Hence, we embed a thin fabric(shown in purple here) on one side of the sensor. The stiffness of this fabric is much greater than either of the rubbers. This shifts the neutral axis of the whole sensor closer to the rubber-fabric interface. Hence, as shown, the conductive rubber can now be placed on just one side of the axis. This way not only can we get the direction of the bend but also its magnitude.

**The neutral axis of a cantilever beam lies where there is no elongation or compression when the cantilever beam is bent. If the stiffness of the beam is constant over its depth, the neutral axis is always at the centre of the beam.*






# Cost Analysis

***Cost of unreported water lost-***

$$C_{wlu} = c.\, l_t,\frac{l_p}{2l_0}.\,(r_m.\, f_m + r_s.\, f_s)$$

***Cost of reported water loss***

$$C_{wlr} = c.\, l_t.\, t_r.\, (\frac{r_m.\, f_m(1 - f_{mu})}{f_{mu}} + \frac{r_s.\, f_s(1 - f_{su})}{f_{su}})$$

***Cost of humans salery to pin point the leak***

$$C_h = \frac{l_p}{l_t}.\, l_t(f_m + f_s).\, c_t$$

***Cost of equipments for humans to pin point the leak***

$$C_e = (f_s + f_m).\,\frac{l_t.\, l_p}{l_a}.\, c_a$$

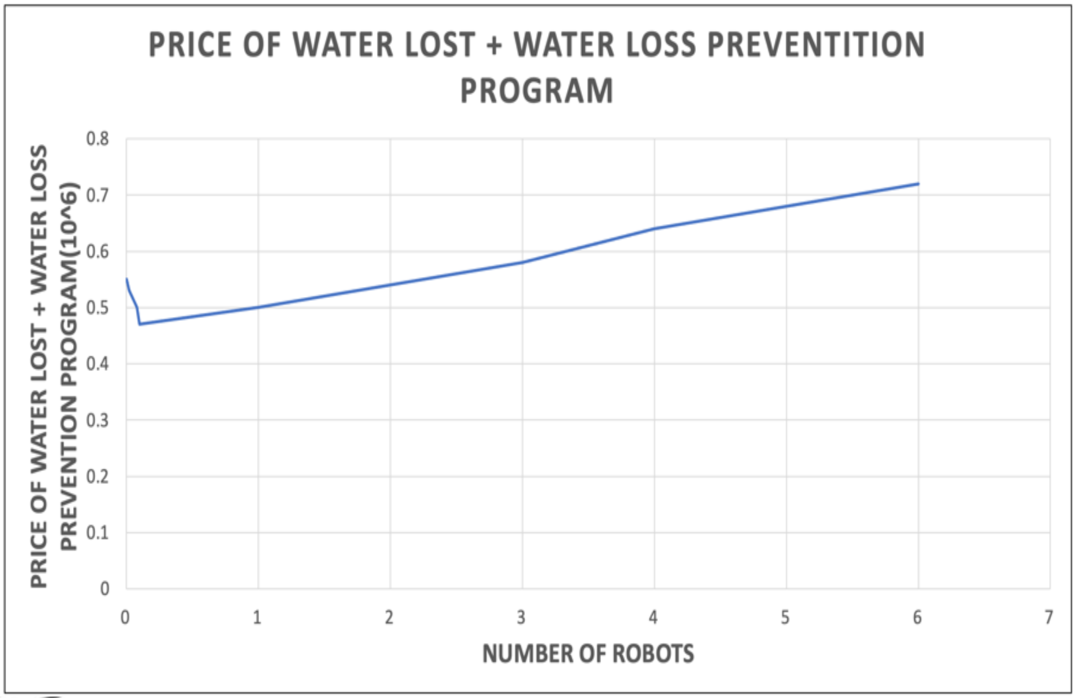
***Cost of a smart flowmeter per year***

$$C_f = \frac{f_c + f_c.\, f_{mc}}{f_t}$$

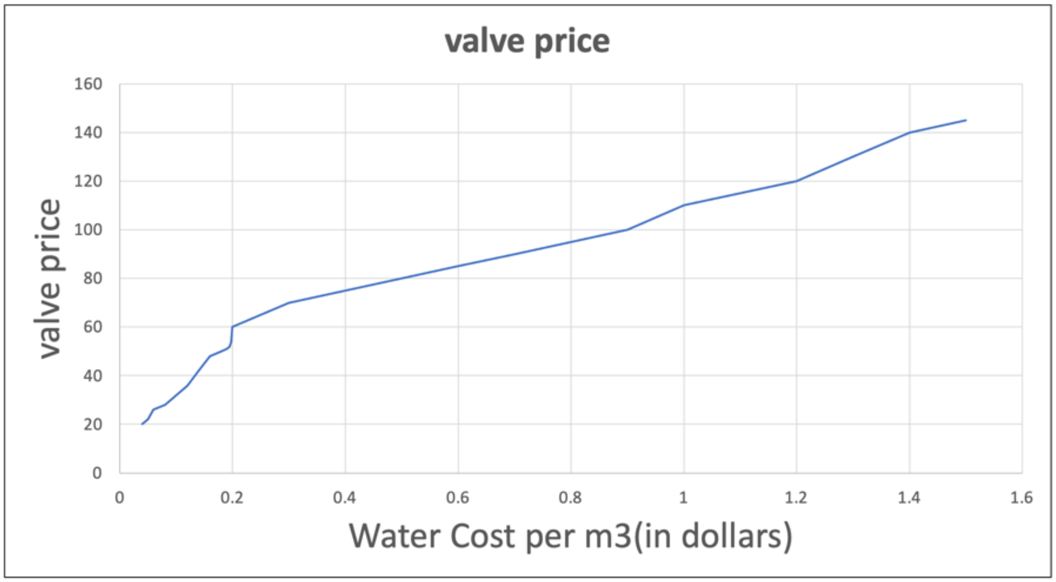
***Overall cost of management system and water lost per year***

$$C_o = C_{wlu} + C_{wlr} + C_h + C_e + n_f.\, c_{f+C_p}$$

## Cost of Leak Detection Via Robots, Valves, and Flowmeters




## Price of Valve to Match DMA Method Cost



## LEARNING OUTCOMES:

1. It promotes the concept of conservation of water.
2. It provide an knowledge about pressure distribution in pipe.

## SOCIAL BENEFITS:

- Reduce the loss of water.
- It will prevent water scarcity.
- It gives an accurate information about leakage.
- It gives exact location about leakage.

## BUDGETARY REQUIREMENTS:

| S.NO | ITEM | SPECIFICATION | QUANTITY | COST/UNIT | TOTAL COST |
|---|---|---|---|---|---|
| 1 | Pressure sensors | 32mm | 2 | 566 | 1132 |
| 2 | Eco flex and moldstar | 00-30 | 1 | 2459/piece | 2459 |
| 3 | Lipo battery | 3.7v110mAH | 1 | 130/piece | 130 |
| 4 | 9 degree of freedom IMU | | 1 | 1139/piece | 1139 |
| 5 | Micro card reader | | 1 | 50/piece | 50 |
| 6 | Battery plug | | 2 | 150 | 300 |
| 7 | Epoxy coating | | 1(300ml) | 500/bottle | 500 |
| 8 | Silc pig red | | 1 | 1780/bottle | 1780 |
| 9 | Transparent pvc pipe | | 2m | 500/meter | 1000 |
| | | | | | |
| | | | | **Total amount** | **7480** |

# THANK YOU

*(If you have any doubts, then feel free to ask us)*