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Design of Suction Pump Manhole

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Abstract: In many places in India because of variations in terrain, water logging takes place. In urban areas, this preventing the smooth flow of traffic, till now there does not subsist, any automatic drainage system which can clear the standing water. Many a time resident has to resort to opening the manhole cover for the water to drain. This is a hazardous situation because people and belongings can unknowingly be washed into the manhole. To alleviate this problem we propose the design of a suction pump man hole. This manhole is covered by a rolling shutter. In the event of a heavy rain the rolling shutter can be operated by a wireless remote. The opening of the rolling shutter exposes a wired metallic mesh preventing the suction of useful materials into the manhole. It has been seen that even when the manhole is open, the rate at which the water is sucked into the drain is limited. This blocks the traffic and purposeful utilization of community resources till the water effectively drains away on its own. To accelerate the draining processes we propose to employ a suction pump. The rolling shutter, the wireless mechanism so associated and the suction pump are all controlled with the help of a microcontroller board. There is a need to provide a separate battery backup mechanism so that the system is operational even during power failure.

Keywords*:* rolling shutter,suction pump,manholes;

I. INTRODUCTION

In our country we face a lot of problems due to poor drainage and water stagnation after rain. In many places in India because of variations in terrain, water logging takes place. In urban areas, this is preventing the smooth flow of traffic. There is no automatic drainage system which can clear the standing water. Many a time resident has to resort to opening the manhole cover for the water to drain. This is a hazardous situation because people and belongings can unknowingly be washed into the manhole.

Poor drainage system

Poor drainage is the greatest enemy of Indian roads. The Central Road Research Institute (CRRI) says 75% of road repair costs can be saved if the drainage system is improved in the city. P K Jain, head of the department and chief Scientist at CRRI, says, "The number one reason for bad roads is poor drainage. If the drainage system is improved, 75% of road repair costs can be saved". The scientist adds that even roads built using "good" technology deteriorate quickly because of the poor drainage along roads, where side drains have been left choked or encroached upon.

To cite a News item from Tribune

"Residents of the Shakti Nagar locality in Jammu are up in arms against the Jammu Municipal Corporation (JMC) for its failure to cover open manholes in the area. The residents say these manholes have become threat to the lives of people here."

A boy walks past an open manhole at a market in Shakti Nagar, Jammu. Tribune photo: Inderjeet Singh

Problems caused by poor drainage

Removing storm water and household wastewater (sometimes called "sullage") is an important environmental health intervention for reducing disease. Poorly drained storm water forms stagnant pools that provide breeding sites for disease vectors. Because of this, some diseases are more common in the wet season than the dry season. Household wastewater may also contain pathogens that can pollute groundwater sources, increasing the risk of diseases such as lymphatic filariasis. Poor drainage can lead to flooding, resulting in property loss, and people may even be forced to move to escape

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floodwaters. Flooding may also damage water supply infrastructure and contaminate domestic water sources.

Some of the horrifying stories are best captured by pictures.

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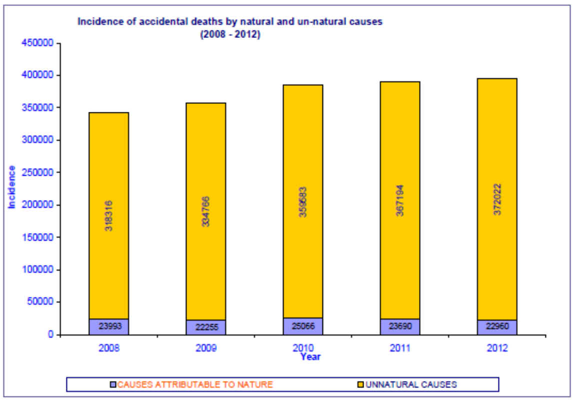
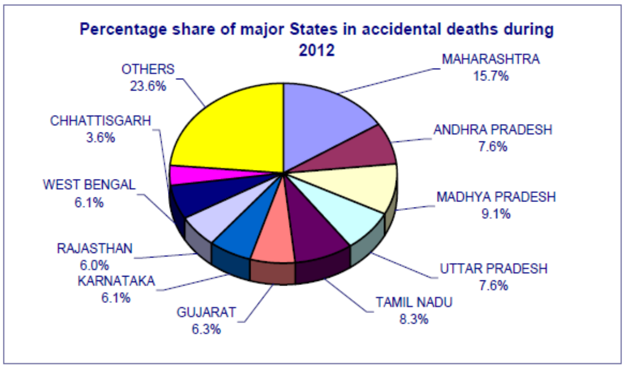


Incidence & rate of accidental deaths in States, UTs and Cities (Table-1.1)



Table—1 (D)
Incidence, share & rate of accidental deaths by causes attributable to nature and un-natural causes during 2011 & 2012

Sl. No.	Cause	2011 No.	2011 % share (w.r.t. All India)	2011 Rate	2012 No.	2012 % share (w.r.t. All India)	2012 Rate	% variation of incidence in 2012 over 2011
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
A. CAUSES ATTRIBUTABLE TO NATURE:								
1	Avalanche	60	0.0	0.0	40	0.0	0.0	-33.3
2	Cold and Exposure	849	0.2	0.1	997	0.3	0.1	17.4
3	Cyclone/Tornado	117	0.0	0.0	47	0.0	0.0	-59.8
4	Starvation/Thirst	136	0.0	0.0	205	0.1	0.0	50.7
5	Earthquake	69	0.0	0.0	3	0.0	0.0	-95.7
6	Epidemic	127	0.0	0.0	80	0.0	0.0	-37.0
7	Flood	585	0.1	0.0	420	0.1	0.0	-28.2
8	Heat Stroke	793	0.2	0.1	1247	0.3	0.1	57.3
9	Landslide	302	0.1	0.0	282	0.1	0.0	-6.6
10	Lightning	2550	0.7	0.2	2263	0.6	0.2	-11.3
11	Torrential Rains	170	0.0	0.0	203	0.1	0.0	19.4
12	Other causes attributable to nature	17932	4.6	1.5	17173	4.3	1.4	-4.2
	Total (A)	**23690**	**6.1**	**2.0**	**22960**	**5.8**	**1.9**	**-3.1**
B. UN-NATURAL CAUSES								
1	Air-Crash	18	0.0	0.0	14	0.0	0.0	-22.2
2	**Collapse of Structure:**	**3161**	**0.8**	**0.3**	**2682**	**0.7**	**0.2**	**-15.2**
	(i) House	1050	0.3	0.1	865	0.2	0.1	-17.6
	(ii) Building	424	0.1	0.0	334	0.1	0.0	-21.2
	(iii)Dam	44	0.0	0.0	31	0.0	0.0	-29.5
	(iv) Bridge	119	0.0	0.0	64	0.0	0.0	-46.2
	(v) Others	1524	0.4	0.1	1388	0.4	0.1	-8.9
3	**Drowning:**	**29708**	**7.6**	**2.5**	**27558**	**7.0**	**2.3**	**-7.2**
	(i) Boat Capsize	849	0.2	0.1	668	0.2	0.1	-21.3
	(ii) Other Cases	28859	7.4	2.4	26890	6.8	2.2	-6.8
4	Electrocution:	8945	2.3	0.7	8750	2.2	0.7	-2.2
5	**Explosion:**	**532**	**0.1**	**0.0**	**403**	**0.1**	**0.0**	**-24.2**
	(i) Bomb explosion	149	0.0	0.0	87	0.0	0.0	-41.6
	(ii) Other explosion (Boilers etc.)	383	0.1	0.0	316	0.1	0.0	-17.5
6	**Falls:**	**11867**	**3.0**	**1.0**	**12319**	**3.1**	**1.0**	**3.8**
	(i) Fall from Height	10020	2.6	0.8	10567	2.7	0.9	5.5
	(ii) Fall into Pit/Manhole etc.	1847	0.5	0.2	1752	0.4	0.1	-5.1
7	Factory/Machine Accidents	1091	0.3	0.1	1007	0.3	0.1	-7.7
8	**Fire:**	**24576**	**6.3**	**2.0**	**23281**	**5.9**	**1.9**	**-5.3**
	(i) Fireworks/Crackers	237	0.1	0.0	505	0.1	0.0	113.1
	(ii) Short-Circuit	1523	0.4	0.1	1439	0.4	0.1	-5.5
	(iii) Gas Cylinder/Stove Burst	4005	1.0	0.3	3746	0.9	0.3	-6.5
	(iv) Other Fire Accidents	18811	4.8	1.6	17591	4.5	1.4	-6.5
9	Fire-Arms	1250	0.3	0.1	1217	0.3	0.1	-2.6
10	**Sudden Deaths:**	**26649**	**6.8**	**2.2**	**28961**	**7.3**	**2.4**	**8.7**
	(i) Heart Attacks	16565	4.2	1.4	18522	4.7	1.5	11.8
	(ii) Epileptic Fits/Giddiness	4656	1.2	0.4	4023	1.0	0.3	-13.6
	(iii) Abortions/Child Birth	881	0.2	0.1	938	0.2	0.1	6.5
	(iv) Influence of Alcohol	4547	1.2	0.4	5478	1.4	0.5	20.5
11	Killed by animals	1233	0.3	0.1	959	0.2	0.1	-22.2
12	Mines or quarry disaster	385	0.1	0.0	359	0.1	0.0	-6.8
13	**Poisoning:**	**29478**	**7.5**	**2.4**	**30748**	**7.8**	**2.5**	**4.3**
	(i) Food Poisoning/Accidental Intake of Insecticide	8972	2.3	0.7	8500	2.2	0.7	-5.3
	(ii) Spurious/poisonous liquor	1435	0.4	0.1	731	0.2	0.1	-49.1
	(iii) Leakage of poisonous gases Etc.	181	0.0	0.0	169	0.0	0.0	-6.6
	(iv) Snake Bite/Animal Bite	8590	2.2	0.7	8891	2.3	0.7	3.5
	(v) Other	10300	2.6	0.9	12457	3.2	1.0	20.9
14	Stampede	489	0.1	0.0	70	0.0	0.0	-85.7
15	Suffocation	2013	0.5	0.2	2075	0.5	0.2	3.1
16	**Traffic Accidents:**	**165072**	**42.2**	**13.6**	**168301**	**42.6**	**13.9**	**2.0**
	(i) Road Accidents	136834	35.0	11.3	139091	35.2	11.5	1.6
	(ii) Rail-Road Accidents	2366	0.6	0.2	1808	0.5	0.1	-23.6
	(iii) Other Railway Accidents	25872	6.6	2.1	27402	6.9	2.3	5.9
17	Other Causes	39473	10.1	3.3	41611	10.5	3.4	5.4
18	Causes Not Known	21254	5.4	1.8	21707	5.5	1.8	2.1
	Total (B)	**367194**	**93.9**	**30.3**	**372022**	**94.2**	**30.7**	**1.3**
	Grand Total (A+B)	**390884**	**100.0**	**32.3**	**394982**	**100.0**	**32.6**	**1.0**

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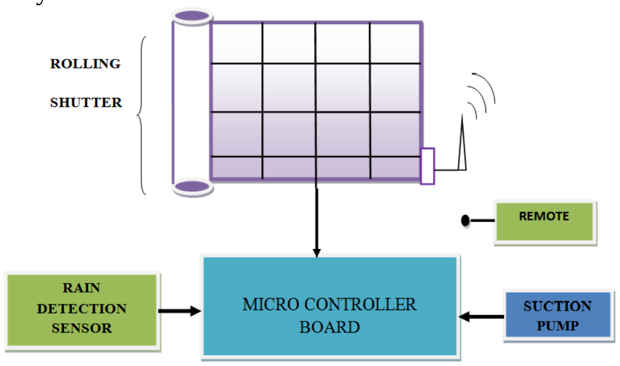
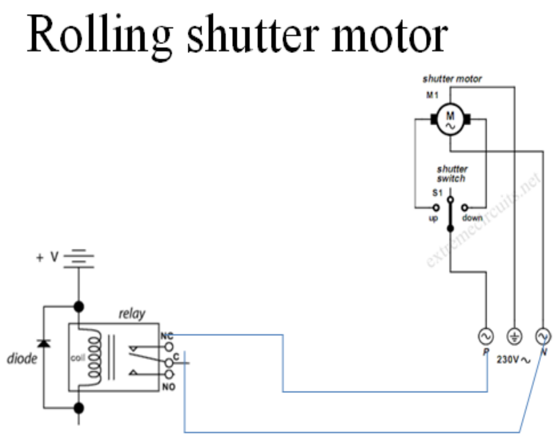
A table showing death by natural and unnatural causes is shown above:

If we zoom into the relevant part we see the following figures:

Falls:	**11867**	**3.0**	**1.0**	**12319**	**3.1**	**1.0**	**3.8**
(i) Fall from Height	10020	2.6	0.8	10567	2.7	0.9	5.5
(ii) Fall into Pit/Manhole etc.	1847	0.5	0.2	1752	0.4	0.1	- 5.1

To alleviate this problem we propose the design of a suction pump man hole. This manhole is covered by a rolling shutter. In the event of a heavy rain the rolling shutter can be operated by a wireless remote. The opening of the rolling shutter exposes a wired metallic mesh preventing the suction of useful materials into the manhole. It has been seen that even when the manhole is open, the rate at which the water is sucked into the drain is limited. This blocks the traffic and purposeful utilization of community resources till the water effectively drains away on its own.





II .SUCTION PUMP

To accelerate the draining processes we propose to employ a suction pump. The rolling shutter, the wireless mechanism so associated and the suction pump are all controlled with the help of a microcontroller board. There is a need to provide a separate battery backup mechanism so that the system is operational even during power failure.

If we assume that draining starts at a time t=0 and we denote V(t) to be the volume of water that was drained from the road from the time the draining started and also let W(t) denote the remaining water that is left on the road we can derive the appropriate mathematical relationships which govern the desired behaviour.

If V0 denotes the water at the beginning the following formula governs the drain problem.

$$W(t) = V_0 - V(t), \qquad V(t) = V_0 - W(t).$$

Pump with a constant action

A hose is connected to one end of the pump and the other end accepts water from the road and the pump is started. Let us say that the pump drains water at a steady rate of k liters per minute.

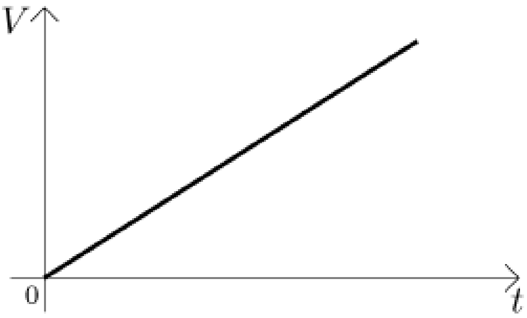
If the draining starts at a time 0 the volume taken out at a certain time t is governed by the formula:

$$V(t) = k \cdot t.$$

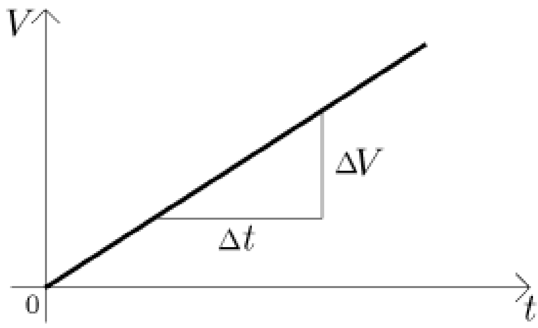
If we want to assess the water drained between times t1 and t2, this is governed by the relation:

$$k \cdot (t_2 - t_1).$$

In such a case the graph of V is as shown below:



Here the drainage constant is given by the slope of the line as shown above.



If we take a time interval somewhere on the x-axis, denote its size by Δt, and by ΔV we denote the corresponding output of water from the tank during this interval, then

$$\frac{\Delta V}{\Delta t} = k. \qquad (1)$$

Pump with a variable action

A real life pump does not work at a constant rate, because its action is influenced by many things, for instance the current supplied to its engine is never truly constant, the engine itself may exhibit some irregularities, etc.

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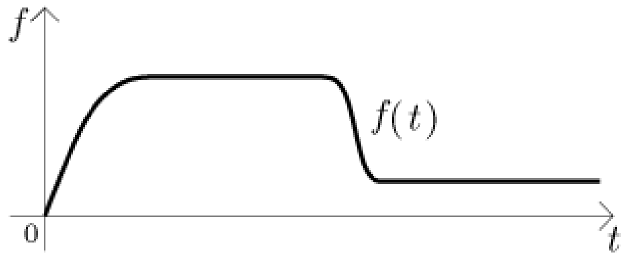
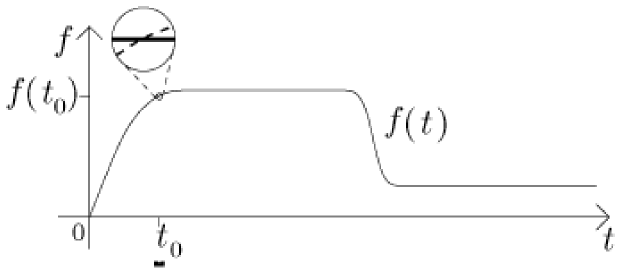
The rate at which it drains the water is therefore not a constant, but depends on time. As such it can be described by some function. For the purpose of this example we will assume that this rate (we will denote it by f) is given by this graph, we chose something simple.



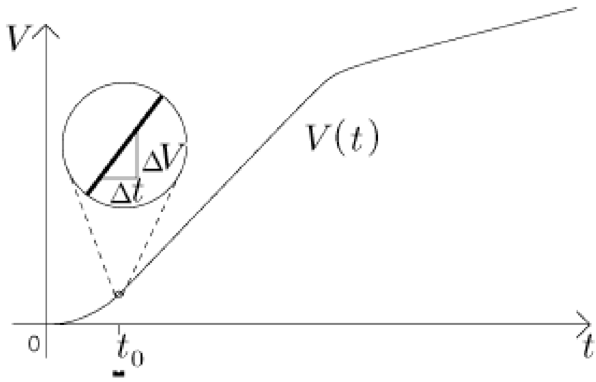
At the beginning we switched the pump on, but a real pump does not immediately jump to its peak performance, it goes there gradually. Then the pump ran at a (seemingly) constant rate for a while, then we lowered its draw (again, the change

One thing is clear, since f is not constant, we cannot use the previous procedure to get the whole answer. did not happen immediately).

Take some time t_0 and consider a very tiny time segment around this particular time. Since f does not look too wild, we may assume that if we take a really tiny segment, then f does not change almost at all on this segment, therefore we can assume that it is actually constant there without making a large error.



If we focus on that particular segment where we take f as a constant, we can apply the conclusions from the previous example (we discussed it there), in particular the graph of V is (on this segment) essentially a straight line with slope equal to $f(t_0)$. Taking a hint from the first example, we can consider some triangle adjacent to that straight part of the graph of V with horizontal side of length Δt and the corresponding change in volume denoted by ΔV.



In this project we make use of Liquid Pump - 350GPH (12v)

Features:

12V operation

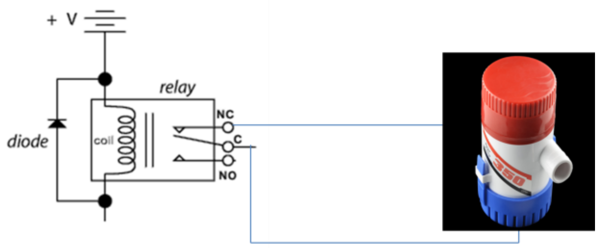
350 GPH

1.5A motor

¾" barbed outlet

3ft long wire leads

The connection diagram for the pump is as shown in the figure:



This fluid pump will move 350 gallons per hour! The SEAFLO mini water pump has a heavy duty 12V, 1.5Amp motor and a tough thermoplastic body. It's totally submersible and water-cooled (but it won't burn out if run dry).

The ¾" connection will accept a 19mm ID hose. It comes pre-terminated with heavy gauge unterminated 3ft long wire leads.

Internally it's just a centrifugal impeller disc on a shaft (as basic as it gets). While pumps of this type have large flow rates and easily about 3 or 4 feet of Head, they will not produce any useful pressure over 1 or 2 PSI.

Not only are they submersible, but they MUST be submerged to operate, as the inlet is the blue vented plastic piece at the bottom (this piece is meant to be removed, screwed to the bottom of the bilge and re-attached).

They will happily run dry for hours with no noticeable negative effects, they are not actively water cooled, and any cooling on the water's part is merely radiant heat from the plastic case. The motor itself is completely sealed off in the plastic body save for the shaft with the impeller disc on it.

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III.AUTOMATIC ROLLING SHUTTER DESIGN

Several types of rolling shutters are available in the market today.

1. Manual rolling shutter

With gear drive from the shutter roller traced through the building facade to a universal joint on the room side that is operated by a cranked winding handle.

2. Manually operated gear type

If the size of shutter is more the gear will drive center shaft of the shutter

3. Motorized shutters

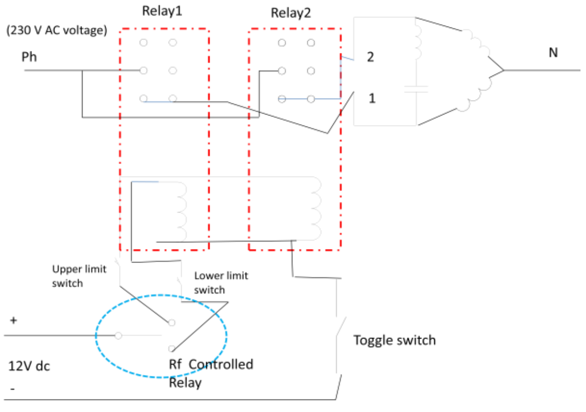
The automation of a shutter is obtained by simply inserting the motor, known as tubular due to its form, inside the tube around which the shutter is wound. Control can be from the immediate vicinity, with a simple wall-mounted control, or via radio with a portable radio control. The motor is powered by 230 V current. The motor moves reliably and precisely and is available with an emergency man oeuvre which can be used during black-outs to action the rolling shutter.

- In case of motorized shutter the capacity of motor varies according to the size of the shutter.
- Reversible single & 3-phase motors are used.
- It has up and down control switches
- It can be operated through remote switch.
- If the mounting area is weak then, in that case we have to put steel beam.

Automating a pre-existing rolling shutter is easy, convenient and fast thanks to the possibility of installing an automation system via radio with a control unit built in the tubular motor.

This solution avoids the cost and burden of masonry or the installation of unsightly cable ducts for routing control cables.

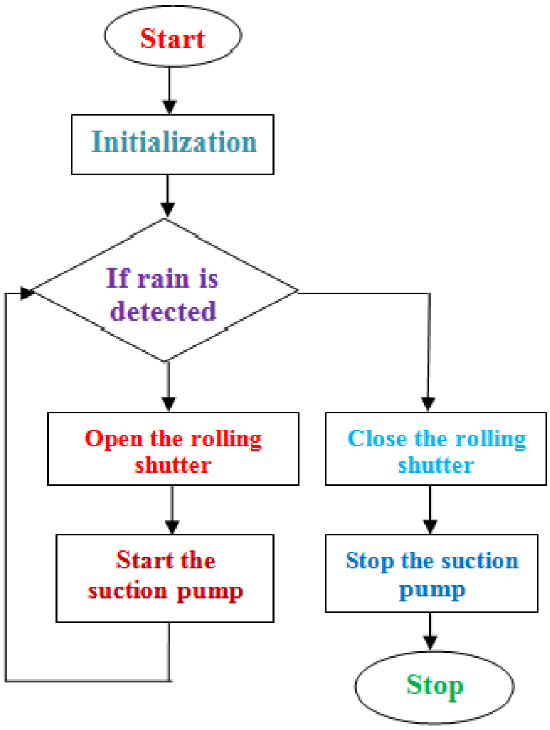
Automated rolling shutters avoid any effort for opening/closing, and guarantee perfect closure of the home in your absence.



Operation of rolling shutter

The automatic rolling shutter contains components like Stepper geared motor of reversible type, 2 relays, one RF controlled relays and toggle switch. The purpose of toggle switch is to stop the moments of relays initially. When it is OFF neither of them (relays) will be connected. Relay1 is up moment of rolling shutter.Relay2 is for down moment of rolling shutter. When toggle switch is closed after power supply is ON,RF controlled relay is controlled by remote is connected to up mode. When remote is on then relays works. The relay switch connected to motor of node 2.then motor drives rolling shutter upwards **up** to the upper limit switch (limit switch open).now if the remote button is pressed then RF controlled relay connected to Relay1 switch(down switch).Relay1 connected to node 1 of motor, then motor drags rolling shutter down up to lower limit switch open.

FLOW CHART



IV. CONCLUSION

The analysis conducted in this paper has shown that dangerous Situation can arise with the manholes when heavy rain occurs. According to experts, while poor drainage facilities and shoddy maintenance of the existing drainage systems are the primary reasons for potholes and poor quality of roads, another major reason is the dying of soaking areas in urban habitats. Therefore, automatic drainage system should be employed to clear the standing water. Undertaken action to prevent the risks of persons and things washed into the manhole.

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