**Borewell Rescue Bots**

**Introduction: -**

It is estimated that a total of 5 child deaths happens per day due to open Borewell all over India. Children and very few adult falls in borewell due to many reasons. Some of them include Uncovered and improper maintenance after work, not monitoring kids during playtime, delay in daily tasks given to labors, and etc. The main reason behind Borewell deaths are, they are extremely narrow, so child inside borewell do not get enough oxygen and might die due to delay in rescue operations.

The main focus of the Borewell Rescue bots is to rescue people and children with minimum damage and efforts.

**Major Sensors/Components Used: -**

* Temperature Sensor – Used to measure child temperature as well as surrounding temperature.

In most cases Thermistor is not used because of its accuracy.

LM35 Temperature Sensor(suggested) is generally used because,

1. It is a Precision IC sensor.
2. More accurate than Thermistor.
3. It has very less self-heat. An increase in 0.1°C occurs in still air due to the sensor.

* APR Module – Used to communicate with the child. This is usually an additional component used to motivate and guide the child.
* Arm or Kinematic Links – This helps in transferring the load of the child or adult with greater mechanical advantage and less effort.
* Servo Motor – The joints of the Arm are rotated with the help of the Servo motor. Unlike DC or AC motor, this motor is used to adjust the angle of rotation of the arm.
* Cameras – This is used to visualize the subject inside the well.

1. CCTV Cameras – Used to provide approximate location of the subject.
2. Infrared Waterproof Cameras(suggested) – This Cameras track IR rays reflected by the body of subject. Thereby, subject can be tracked with utmost accuracy.

* High Definition Wired or Wireless Monitor.
* Human Detection Sensors (HS-101)/ PIR Sensors – These sensors are used in place of Cameras and Monitor. These are Pyroelectric Sensors, which gets activated when heat is produced by the human or animal body.
* Oxygen Concentrator – This is alternative for Oxygen cylinders. They are used to deliver oxygen for the subject in low oxygen borewells.

1. Draws ambient air and produced medical grade Oxygen with 90% to 95% purity.
2. Pipes are used to deliver oxygen in a burst with some time interval.

**Major Techniques Used/ How it Works: -**

* Normal rescue operation started involves digging a parallel pit or hole to reach the child and adjacent holes are made perpendicular to child and rescued. This method is flawed in many ways.

1. Time consumed in making a parallel hole is very high. Which results in decrease in oxygen for the subject trapped in the hole.
2. The drilling operation adjacent to the pit might create vibration, which might lead to further fall into the pit.
3. Lot of man power and efforts needed.

* L Rods Panel: -

This is most basic type of Borewell rescue system, which has a very basic component. A copper L rod is used to change the form of a straight rod to an L shape when desired.

This way the rod can be inserted below the subject and the shape of the rod is changed and the subject is lifted.

But this has flaws, when lifting the rod might not lift heavy loads and could break.

* Safety Balloons with Pneumatics Pipes: -

This is also the basic type of Borewell rescue system, which is believed to be cheap and works perfectly. But the question, whether the safety of the subject predictable? No, this system does not provide basic needs such as Oxygen supply, Visualization of the baby, or the location of the baby in the pit.

The technique used in this process is, the structure has a fiber elastic cushion-based balloon, and a steel base and a steel top.

First the balloon is inserted below the subject, this is achieved by the sleek and durable design of the balloon. After the insertion of the balloon, it is inflated by the pneumatic pipes attached to it. This Balloon acts as a cushion base, and the subject legs are supported by the cushion and the body is slowly but steadily lifted to prevent the scratches in the body of the subject.

* Manipulators: -

This is a rescue system or a bot which can be reprogrammed or by changing the end effector can be used for different purpose.

Manipulator is a robotic arm system which has a fixed base.

In this type of rescue bot, a kinematic link or arm is built which is connected with a gripper or a cushion base as an end effector. This gripper is used to hold the subject and helps in lifting.

The manipulator type bot is generally equipped with Temperature sensor, APR module, Servo motors, Cameras and monitor.

Some manipulator with high performance, could have Altitude sensor for exact location of the subject.

This Manipulator is connected with microcontrollers or PC for brain, which can be reprogramed and used as Pipe cleaning machines and Pipe inspection system.

This manipulator can be used either as a wired machine or a wireless machine depending on the altitude of the subject.

* Prosthetic Borewell rescue system: -

This is an advance form of manipulator type borewell rescue bot, which uses Prosthetic equipment as an end effector which is either connected with an arm or steel wires (For very long borewells).

This type of bot uses human sensor or pyroelectric sensors for better physical rendering for high accuracy.

**Advantages: -**

* Manipulators type bots can supply Oxygen, monitor heart rate of the subject (if needed), provides supporting platform to lift child or person.
* Multitasking can be done with single bot, by giving minimal changes to the component of the bot and reprogram it.
* Less manpower is used with rescue bot.
* Less effort is needed. With only a remote and a monitor, anyone can save the subject.
* No/Less Technical knowledge is needed to operate the bot.
* Time required to save the subject is exponentially less compared to normal ways.

**Disadvantages: -**

* The damage that might occur to the subject during rescue of the child by a recue bot is unpredictable. In normal ways such as digging parallel pits, subject is directly rescued at the spot where he/she is stuck. So, damage is very less to the subject.
* A bot might fail during the rescue process because a machine generally faces many technical issues. In case of rescue operations, a failure of bot might cost life.
* Skilled and trained people are required to use the bot. Though this machine is simple to use and anyone can use it, it is highly challenging for everyone to save a person or child in the borewell.
* Erosion of the soil bed might occur as the arm or wires of the bot will always be in the contact with the surrounding soil of the borewell. This might cause serious injuries to the subject.

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