DESIGN AND OPTIMIATION OF CHILD RESCUE DEVICE

[1]S.PRABHU,[2]R.PRANESH AND [3]M.PAZHANIAPPAN [M.E.,(Ph.D).]

Mechanical Engineering Department,
prince Shri Venkateshwara Padmavathy
Engg.College, India

ABSTRACT

Children often fall down in the borewell which have been left uncovered and get trapped. The rescue of this trapped children is not only difficult but also risky. A small delay in the rescue can cost the child his or her life. To lift the child out the narrow confines of the bore wells is also not very easy. The child who has suffered the trauma of the fall and is confined to a small area where, with a passage of time the supply of oxygen is also reduces. Device for borewell rescue offers a solution to these kind of situations. It is fast, economical and safe. We are using wiper motor and wire rope with clamping mechanism to lift the baby from the borewell.

Keywords: *Child rescue in borewell*

INTRODUCTION

The Bore wells are left unclosed after identifying that ground water is not abundant at the place. These bore wells in turn have started to take many innocent lives. There is no proper technique to rescue victims of such accidents. So used a morphological analysis, is a method for representing and exploring all the relationships in multidimensional problems. The word morphology means the study of shape and form and a way of creating new forms. The process was developed into a technique for generating solutions.

1.1 PURPOSE OF CHILD RESCURE ROBOT

In most cases reported a parallel hole is dug up and then a horizontal path is made to reach to the trapped object. Various cases are being encountered where people especially children are accidently falling and trapped in the bore wells. Taking them out safely is one of the most difficult challenges which involve risk and lot of human effort and time. Sometime the bore well is so deeper that a human cannot enter leaving the victim helpless to inside the bore well. There is no proper rescue technique to rescue victims of such accidents. When they make shift local arrangements do not work, army is called in.

Moreover this rescue system involves a lot of energy and expensive resources which are not available easily everywhere and also need a big space around the trapped bore. That approach involves heavy risks including the possibility of injuries to the trapped object during the rescue operations. Also the body may be trap further in the debris and the crisis deepens even more means death. In such methods some kind of hook is employed to hold the sufferers clothes and body. This may cause wound on the body of the trapped object. It is pertinent to mention that a proper technical solution for such emergency crisis is the need of the hour. More so in times of continuous research and technical advancements, techno crafts should take the responsibility to find an easy way out. In which is an issue of social as well as national concern and an early step in the direction of developing an instrument for the rescue of victims of such cases is desirable.

1.2 RESCUE SYSTEM

In such methods some kind of hook is employed to hold the sufferers clothes and body. This may cause wound on the body of the trapped object. It is pertinent to mention that a proper technical solution for such emergency crisis is the need of the hour.More so in times of continuous research and technical advancements, techno crafts should take the responsibility to find an easyMway out. In which is an issue of social as well as national concern and an early step in the direction of developing an instrument for the rescue of victims of such cases is desirable

The expected number of wells and borewells in India is now reducing and there are only twenty-seven million borewells. Growing water scarcity is one of the most important problems in India. Since the water level is decreasing day by day so more peoples are affected. Borewells are constructed to overcome water scarcity. These borewells are left opened after finding that ground water is not abundant in that place. Borewells that yielded water and subsequently got depleted are left uncovered. The bore wells in turn have started to take many innocent lives. Small children without noticing the borewell fell inside and get trapped. There is no proper technique to rescue in case of such accidents. In most cases a parallel hole is dug up and then a horizontal path is made to reach to the baby. It takes nearly 20-60 hours to dig the parallel pit, by that time the child would have lost its life.

It is a time taking process, and also risky in various ways. There is possibility of injuries to the child inside the bore well. Whatever may be the case the success ratio depends on lots of factors like availability of time taken for transportation of machinery to the situation, human resources and mainly the response time of various government organizations. In India according to the NCRB (National Crime Records Bureau) report of 2011 there are 5 average deaths per day in the license bore wells.

Some of the works related to the robotic system and rescue of child from borewell is implemented a robotic hand that has the ability to identify object based on tactile sensor and can extract features from single grasp, the pressure sensors are also equipped with the robotic hand. This technique can be applied to the robotic arms involved in the rescue operation of children from borewell but this system has more sensors which makes the circuit more complex and also large power consumption. Another proposed machine which aids the rescue operation by providing support system such as oxygen supply system and they also provide a software which indicates the level of temperature. The above method provides an alternate approach to conventional rescue system but fails to rescue the child from the borewell moreover the child cannot survive if the rescue operation takes longer time. Then a controller based system to control the entire rescue operations and also it uses wireless transmission as a model for communication but only the simulation of rescue operation is shown and the hardware model is not implemented.

1.3 CHILD RESCUE ROBOT

Then a robotic machine was proposed to rescue a child from the borewell, this model consists of robotic arm which will evacuate the child from the pit. The main concern with this implementation technique is that, the arm developed to grasp the child is mechanical and it is very difficult to position the robotic arm irrespective to the position of the victim also it may harm the child while holding.

Another problem is that, failure of the arm at the top of the well will cause certain death to the child as no fail-safe mechanism is available. The existing challenges were overcome by the model proposed in our paper which is shown below, then the hardware and software setup of the system is discussed along with the implementation of the model proposed.

1.4 HISTORY OF BOREWELL RESCUE

In India, recently we have witnessed some of the most tragic but helpless incidents which touched us deeply and forced us to look after the matter seriously. As the statistics suggests in the consecutive years starting from 2006, still more than 30 deaths occurred while stuck in bore well.The most mournful fact. in that figure is that 92% of that victim is under the age of 10. The children were playing around the bore well unaware of the fact that the bore well was waiting for them in the form of a death trap. After slipping in the rotten congested pitch black environment they were waiting for the help to come. But the lack of oxygen and deathly atmosphere has taken their life slowly before the rescue team can reach them.

The incident of losing lives trapped in bore-well was highlighted in 2006 where a 5 year old child named Prince was rescued by Indian Army experts after a tough combat which lasted 49 hours. The boy showed tremendous survival instinct by remaining calm and being co-operative with survivors. Statistics reveal that not many kids were as lucky as Prince, many of them died, some received public attention, while many went unnoticed. Another incident in Indore took place in the same year where a child name Deepak stuck in the pit hole and died for the lack of oxygen. We have tried to summarize the incidents in this concern. It's our agony that on April 7,2007 in Village Adsar in Bikaner district (Rajasthan),we witnessed the death of a two year-old girl named Sarika who had fallen in a 155-feet deep open bore-well and on the same day, a two-year-old girl,Kinjal Man Singh Chauhan, fell in an open bore-well in village Madeli (Gujarat) and died. On February 6, 2007, a two-year-old boy, Amit, fell in a 56-feet deep well in a village near Katni (MP) and died. On March 9, 2007, in Karmadia (Gujarat) three year-old died due to same.

On June 17,2007 an open bore-well in village Shiroor (Pune, Maharashtra) claimed the life of a five-year-old child. Six-year old Suraj lost his life when he fell in a 180-feet-deep bore-well in village Nimada (Jaipur, Rajasthan) on July 4th,2007. On August 4,2007 six-year-old Kartik died when he slipped in a 200-feet-deep open bore-well in village BotalaGudur (Andhra Pradesh). This was the year of sorrow as small accidents were taking the lives of innocent children. The most common thing in those incidents was a fact of lack of technology. This didn't stopped hear yet. On March 25, 2008 a three-year-old girl, Vandana, fell in a 160-feet-deep open bore-well in village Tehra near Agra. 2-year old Sonu fell in 150 feet deep bore well pit in the northern state of Uttar Pradesh. He was brought out dead after four days of rescue operation.In 2009, KirtanPranami, an 11-year-old boy from Palanpur in Gujarat died after he fell into a 100ft (30m) bore-well. Within months, two-year-old Darawath Mahesh fell into a 35ft (10m) bore-well in Warangal in Andhra Pradesh and died. Five-year-old child who fell into a 250-feet deep bore-well in Jaipur in 2009 was also saved. Four-year-old AnjuGujjar was rescued also from a 50-foot deep open bore-well in Rajasthan.The redemption of 4-year old Mahi (2012) took army experts 86 hours ordeal combat which led to the death of the poor kid. Other sad incidents in 2012 was the deadly incidents of 4-year old boy of Tamil Nadu (2011), 1-year old Payal of Indore (2012), 12-year old Bakul of Gujarat (2012), or 17-year old Roshan of Howrah, West Bengal (2012).The sadness caries out even now after 6 years from the first case that gain huge limelight and support from the media. Each time something happens we find ourselves ill-equipped to deal with the crisis and the precious time elapses. We first observed an extensive approach from the Indian Army military jawans (L&T ,GMR) in the case of Mahi (2012). As the rescuer team found that the task of picking up the kid in a straight path is not possible, they started to dig up another well in form of a well in not so far distance from the accident spot. An army man was been lowered into the new parallel pit where he started to dig a vertical lane to reach Mahi. The rescue operation is graphically illustrated in the Fig. 3.The operation lasted for around 86 hours and at last what her parents got was the body without internal soul.

MODELING OF BOREWELL RESCUE USING CAD SYSTEM:

There are some good reasons for using a CAD system to support the mechanical design function:

- To increase in the productivity.
- To get better the quality of the mechanical design.
- To uniform design standards. To create a manufacturing data base.

To remove inaccuracies due to hand-copying of drawings and irregularity between Drawings

METHODOLOGY

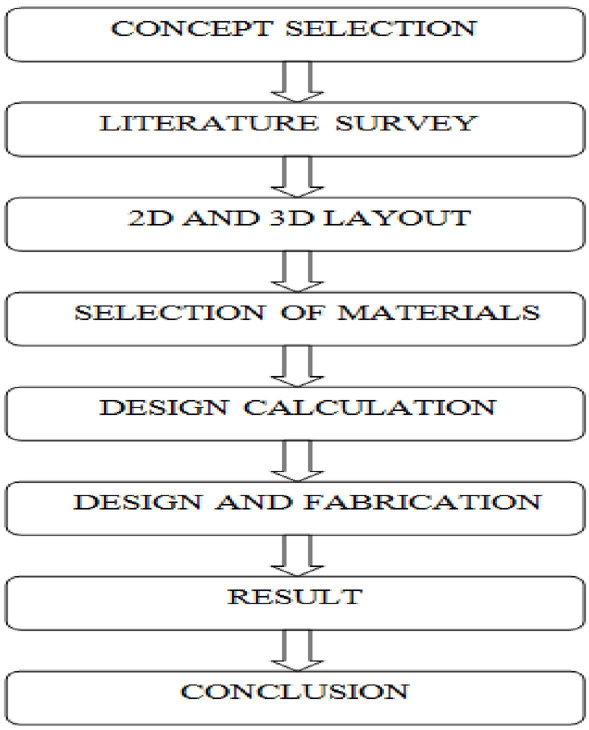


Fig 1 Methodology Flow chart

MECHANISM

4.1 WIPER MOTOR

There are three major components to a wiper motor:

· Motor · Rotary to linear motion converter mechanism · Parking switch

The mechanism to convert rotary motion to linear motion is very straight forward, and its functionality is apparent from a visual inspection of a disassembled motor assembly. This article, therefore, will discuss only the operation of the motor and the park switch. Although written specifically for a TR6, it is typical for many later model British cars. A separate description is provided below for earlier models -TR2, 3, 4, etc.

A) NORMAL OPERATION: Refer to Figure 1. In this mode of operation, the dash switch is in the normal, or low speed, position, and internally, terminal 2 of the switch is connected to terminal 3. Current flows through the motor as shown by the dotted red line. The operation of the parking switch has no effect in this mode, as terminal 4 of the dash switch is not connected to any other terminal.

B) HIGH SPEED OPERATION: Refer to Figure 2. In this mode, the dash switch is in the high speed position, and current flow is as shown. This is basically the same configuration as the normal mode, except the power flows through the high speed brush rather than the normal speed brush. Internally, terminal 2 of the dash switch is connected to terminal 1.

Fig 2 Wiper motor

4.2 CHAIN AND ROPE MECHANISM

Chain or Rope is used to lift the baby from borewell with the wiper motor is connected at end of the rope with clamp mechanism.

An elevator is a device used for lifting or lowering a load by means of a drum or lift-wheel around which rope or chain wraps. It may be manually operated, electrically or pneumatically driven and may use chain, fiber or wire ropes its lifting medium. The load is attached to the hoist by means of a lifting hook. The range of lifting machines can be applied across all industry sectors; from healthcare to construction, most industries and commercial activity will use some kind of lifting equipment. Technological progress has meant that innovative, often complex and powerful lifting equipment is now available for
use.

The principal parts of load-lifting machines are the frame, the lifting mechanism, and the carrying (grasping) system. Self-propelled machines are equipped with a mechanism for movement; rotating types are equipped with a rotation mechanism. The load-grasping mechanism, like the design of the machine itself, depends on the size, weight, and nature of the load to be moved, as well as on the technical aspects of manufacturing process involved. For lifting and lowering people the machine is equipped with cabins and cages; for moving piece goods it has hooks and various special grips; and for bulk materials, it has buckets, dippers, or graders

4.3 LIFTING MECHANISM

Lifting Machine is a machine used for lifting and lowering loads, and includes any accessories used in doing so (such as attachments to support, fix or anchor the equipment).

Examples of lifting equipment include:
• Overhead cranes and their supporting runways
• Patient hoists
• Motor vehicle lifts
• Vehicle tail lifts and cranes fitted to vehicles
• A building cleaning cradle and its suspension equipment
• Goods and passenger lifts
• Telehandlers and fork lifts
• Lifting accessories.

4.4 NYLON ROPE

Nylon fibre ropes are a very attractive proposition because of their low modulus and cost but have previously been thought to have a poor wet fatigue performance. A specially designed long-lay-length Super line sub rope has been tested both for compliance and for wet fatigue performance. The rope compliance is about twice that of parallel-sub rope construction polyester rope. The fatigue performance is less than that of parallel-sub rope polyester rope but is comparable to that of conventional construction polyester rope and to that of the chain and steel wire ropes which must also be used as mooring components. The high compliance of the nylon sub rope construction together with the more than adequate fatigue performance demonstrated in this study qualify such nylon ropes as ideal for WEC mooring systems.

The high compliance properties of nylon require a test machine with a long bed length and a long stroke. The actuator stroke must be sufficient to remove the slack from the sample, and the load capacity must be sufficient to accommodate the fatigue test loads and also to break the rope. The bed length must accommodate a rope specimen which is long enough that there is sufficient
length of undisturbed rope between the splices. For these fatigue tests the ropes should be tested in the wet condition.

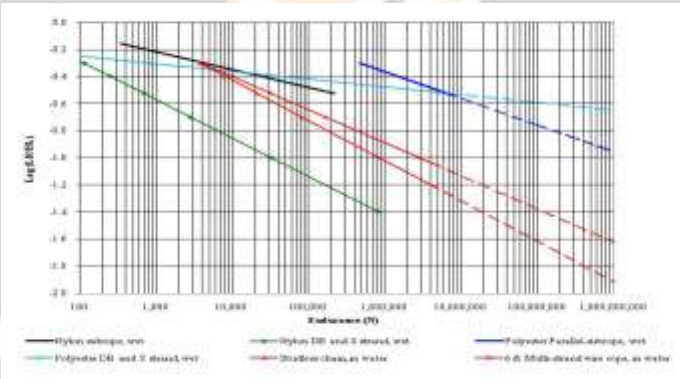


Fig 4.3 Comparison of the results of fatigue tests on the 'new' nylon rope, with the best data available for other material mooring components

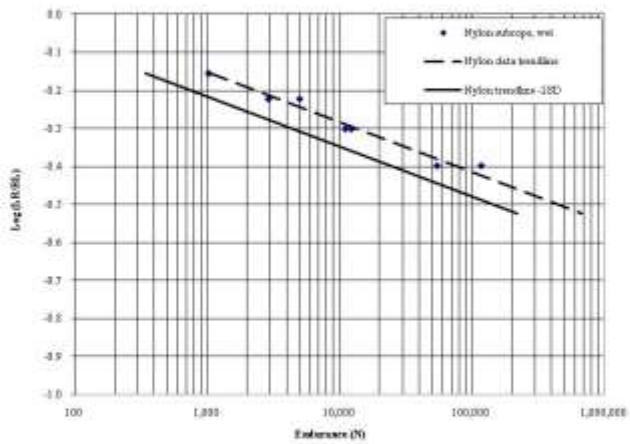


Fig 4.4 Cyclic load - endurance relationship for the nylon subropr detrmined by the fatigue test

4.5 TONGS MECHANISM

The tong is a type of machine that modifies and transforms input forces into desired output forces. Although tongs come in a multitude of shapes and configurations, most of them can be broken down into a simple "four-bar" linkage for analyzing their movement and forces. Although each material handling application will require specific analytical calculations to determine the proper structural configuration of the tong, a simple static analysis of a tong will show important relationships that can be helpful when selecting the proper tong for your application. A simple pressure type tong grab; the specific loads on the links have been exploded for llustration.

Fig 4.5 Supporting Tong

Load (L) = weight of grab + load weight

Based on this equation, we can formulate very important relationships on the movement of a tong:
1. As the magnitude of the X-Links increases with respect to the Y-Links, the gripping force will increase. This is the same principle that is exemplified by a pair of pliers. The link between the claws and handle is small, while the distance from the claws to where your hand closes the handle is much longer. This distance translates into a moment arm and creates the mechanical advantage or gripping force.

2. It is important to remember that X-Links and Y-Links are interdependent, and that the gripping force must stay high enough to prevent the loss of the load. This relationship explains why the grab's headroom increases when the tong is designed to lift a wider variation in widths. As the links swing, more headroom is required (longer Y-Links) which in turn requires more tong overall width (X-Links) to keep the gripping ratio high enough

Supporting Tong – This tong is identified by lifting feet that support the load and maintain it on a horizontal lifting plane. The load is usually a constant size and supported with dun age to allow the tong's feet to slip under the load. The gripping force (the force that the tong exerts on the load) is minimal, so this lifter is excellent for loads which should not be marred by permanent indentation or loads which have an irregular shape but maintain a flat bottom. The supporting tong allows for a very tall load, while minimizing additional head height, since the gripping force is very small (see Relationship #1 in the Mechanics section.) Examples of loads that this type of lifter would handle include boxes, crates, bins and containers

The majority of gripping tongs are equipped with curved plates of varying dimensions to handle different cylinders, pipes and other circular loads. There is a maximum and minimum diameter roll that can be lifted with each grab. If the range of diameters of the different loads is too large, the tong will drag on the floor or adjoining rolls when closing and will slide on the floor when opening. The ratio of small to large roll diameters should generally not exceed 0.80. For example, a single gripping tong could handle pipe from 10 to 12 ½ inches in diameter. The headroom and grip may be increased and this ratio may be reduced, but with a resulting increase in material costs and lifter weight. The curvature of the pad should be ½ of the diameter of the largest load that will be handled by the tong. This will help maximize the contact area between the tong and the load. Some tongs are equipped with pivoting pads to minimize the width of the tong and provide a better lead-in when setting the tong on the load. If the tong has been designed correctly with part of the tong extending below the horizontal centre line of the load for support, grip ratios can be as low as ½ to 1, but 1 to 2 is the usual grip ratio.

DESIGN CALCULATION

5.1 Component Specification

1. Mild steel - grade 12 - 1 inch square pipe
2. DPDT (Double Pole Double Throw) switch - 2 nos - Output - 12v
3. Wiper motor - 2 nos - 13v - 100rpm
4. Nylon rope - 5 m
5. SMPS (Switch Mode Power Supply)converter - 1 nos

5.2 Technical Specification

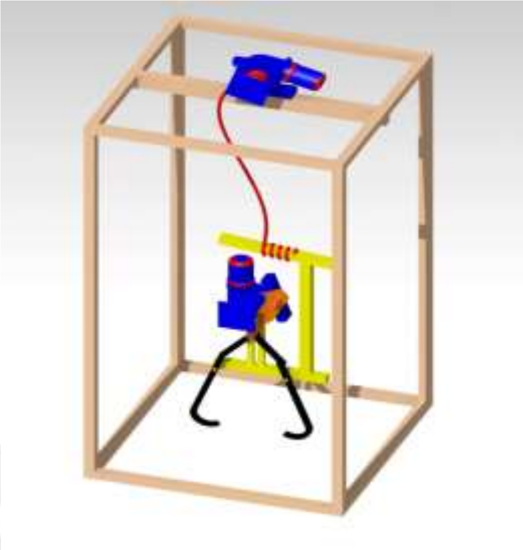
- Rated Torque : 53 in-lb
- Stall Torque : 177 in-lb
- Unload high speed:50rpm,1.5amp (12VDC)
- Unload low speed:35rpm,1.0amp(12VDC)
- Maximum wattage:50w/12VDC
- Motor weight:2.7lbs
- Approx size:7.25*4*3.5

5.3 Wiper Motor Speed

Power supply	Terminal	Speed
12VDC 5Amps	Low	35 RPM
12VDC 5Amps	High	50 RPM
5VDC 5Amps	Low	15 RPM
5VDC 5Amps	High	20 RPM

Table 5.1 Wiper motor speed

3D LAYOUT



EXPERIMENTAL SETUP

7.CONCLUSION

In future we can use this project in several applications by adding additional components to this project. By connecting temperature sensor to the robot we can get the temperature of dangerous zones in personal computer itself instead of sending human to there and facing problems at the field, we can send robots to there and sensor will detect the temperature and it gives information to the Microcontroller and microcontroller gives the information to the transceiver from that we can get the data on the PC side. By connecting smoke sensor to the robot we can get the information related concentration of smoke or gases in respective field's i.e (coal mines, dangerous zones, etc.) Sensor sense the information and it gives to the microcontroller and its gives to the transceiver and from that we get the information on personal computer.

9. REFERRED JOURNALS

1. Manish Raj, P.Chakraborty and G.C.Nandi, “Rescue Robotics in Bore well Environment” ,

2. Indian Institute of Information Technology, Allahabad

3. Palwinder Kaur,“Hardware and Software Implementation of A Robot for Bore-Well Rescue Operations”

4. Palwinder Kaur, Ravinder Kaur, Gurpreet Singh ,“Pipeline inspection and bore well rescue robot”

5. G. Nithin, G. Gowtham, G. Venkatachalam and S. Narayanan ,“Design and simulation of bore well rescue robot – advanced”, VIT University, India

6. B. Bharathi, B. Suchitha Samuel, “Design and Construction of Rescue Robot and Pipeline Inspection Using Zigbee”

7. K.Saran, S.Vignesh , Marlon Jones Louis, “Bore-well rescue robot” in International Journal of

8. Research in Aeronautical And Mechanical engineering

9. “Theory of Machines” by R.S.Khurmi, J.K.Gupta

10. P.S.G – Design Data book http://www.thehindu.com/news/national/ta mil-nadu/in-tamil-nadu-borewell-norms-guard-against-danger/article3566344.ece

11. B. Bharathi, B. Suchitha Samuel “Design and Construction of Rescue Robot and Pipeline Inspection Using Zigbee” International Journal Of Scientific, Engineering and Research (IJSER)

12. Sridhar Palaniswamy “ Life Saving Machine” the first International Conference on
13. Interdisciplinary Research and Development, 31 May-1 June 2011, Thailand.

14. O. Tatar, D. Mandru, “Design of in-pipe modular robotic systems”, Vol.147-149, pp. 49-54, 2009.

15. Alan Mutka and Zdenko Kovacic “A Leg-wheel robotbased approach to the solution of flipper-track robot kinematics”, IEEE International Conference on Control Applications, 28-30 September, 2011, USA.

16. J. Burke and R.R.Murphy, “Human-robot interaction in USAR technical search: Two heads are better than one,”in Proc.IEEE Int. Workshop ROMAN, Kurashiki, Japan, 2004, pp. 307-312.

17. J. Casper and R. R. Murphy, “Human-robot interactions during the robot assisted urban search

18. K. Saran. (2014, Apr.). Bore-well rescue robot. IJRAME. [Online]. 2(4), pp. 61–80.

19. G. Nithin. (2014, May.). Design and simulation of bore well rescue robot - advanced. APRN Journal of engineering and applied sciences. [Online]. 9(5).

20. Dr. C. N. Sakhale. (2013, Oct - Dec.). An approach to design of child saver machine for child trapped in borehole. IASTER. International journal of research in mechanical engineering. [Online]. 1(3), pp. 26–38.

21. Palwinder Kaur. (2014, Aug.). Hardware and software implementation of a robot for bore-well rescue operation. IJETAE. 4(8).
22. M. R. Mansor. (2013, Aug.). Conceptual design of kenaf fiber polymer composite automotive parking brake lever using integrated TRIZ-morphological
23. chart-analytic hierarchy process method. ELSEVIER. Materials and design. 54:473482.