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Theoretical and Practical Analysis on Borewell Rescue Device Using Inspection, Holding and Supporting Mechanism

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***ABSTRACT*-Since the incidence of bore-well accidents in India is higher subsequently from 2006. Hence this paper aimed to design and investigate the bore well rescue system through inspection, holding and supportive mechanism. This paper considers three different cases of weight of children like 12kg, 15kg and 18kg based on which the device was designed. This study designs the device with the help of night vision camera with torchlight, oxygen pipe with an oxygen cylinder, vacuum pipe and suction cup. All the materials used were simple and effective and therefore it would help the rescue of child in both rural and urban areas at cheaper cost. The study conducts theoretical, experimental and ANSYS calculations to show the effectiveness of the proposed device. In this aspect, deformation, stress and strain was measured and observed that the proposed rescue device is suitable for chosen weight cases of children. Hence this method would definitely support the rescue paramedical and operation team efficiently.**

Keywords- Bore-well, ANSYS, Child rescue.

1. INTRODUCTION

Bore well accidents occur when small kids slip through open wells, that are usually neglected owing to the unavailability of water available in the well. Most of the occasions such wells are not protected due to the extra costs involved for filling. Such exposed bore can are life threatening for small kids and infants that quickly fall into such wells. In India, in particular experienced several of the most horrific yet powerless events that have affected us profoundly and compelled us to take a hard look at the issue (refer Figure 1). Attempting to rescue infants

from such incidents is also a problem for the rescue squad. As figures show, more than 30 fatalities happened in successive years all while trapped in the bore well, beginning in 2006[1] . The saddest reality about this statistic is that 92% of the victim is below 10 years of age. The kids played across the bore well clueless of the reality that the bore well had been sitting for them in the shape of a death trap. They were expecting for the aid to arrive since falling in the rotting cramped pitch dark climate. But the oxygen deprivation and the toxic environment took their lives gradually even before rescue crews could enter them. This has shown that the new systems accessible are both less reliable and expensive. Therefore, community needs a new strategy that is more flexible and reliable.

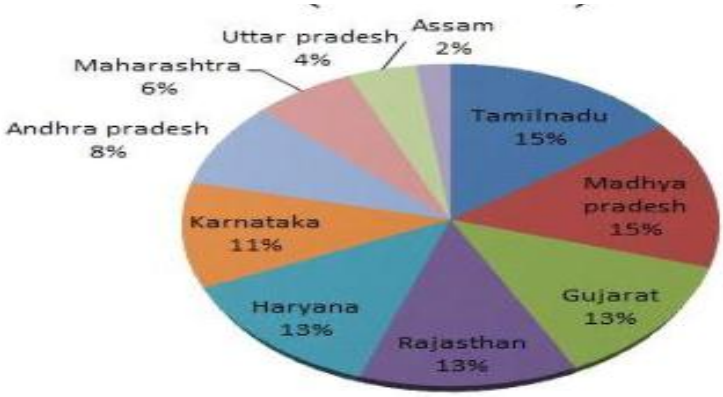

Figure1. Number of Bore well accidents 2006-17, [2]

There are various forms of rescue that have been embraced by different groups of people in order to ensure the survival of the infant. For instance, according to research by Raj et al. (2014), rescue approach that uses a pneumatic arms has been introduced for effective rescue. In order to rescue the child securely, the robot has been fastened with a harness. Nevertheless, fixing the harness to the child is not possible in a small hole for the pick-up procedure. The research of Gopinath and Devika[4]used the Solidworks software to create a robotic arms which can perform various functions for the rescue from the bore well. Nevertheless, the design has not been implemented in practice to illustrate the feasibility of the anticipated solution.

Channabasavaraj *et al*. [5] developed a rescue device based on PC for the infant who are stuck in bore well and it work in an alternate situation where the bore well requires digging of hole and it is done with the help of robots mechanism. The usage of digital signals data (ADE), microcontroller, LED display, DC monitor, liquid crystals and crystalloids dot matrix were denoted by the author. However, this method consumes the man power, huge electronic power and financial expenses; hence it is useful for large scale of industries. A wireless sensor fusion system was designed bySridhar*et al*.[6] in order to evaluate the internal as well as the external condition of bore well. This sensor is attached to a microcontroller with the use of regulated power. The data that are achieved from the signal of the bore well will be received by making use of the wireless RS 485 which is fixed inside the bore well. A RS 232 computer will be used to receive the signals arriving from the bore well. Varied elements like temperature, CO, humidity, oxygen and many others were calculated. The only restriction present in the process was the supply of oxygen in chemical contaminated land which might give out a reaction. This reaction might even produce harmful gases within the borewell and might cause harm or hazard to the child within. A LabView oriented borewell child rescue robot was designed and

implemented bySujatha*et al*. [7], IR technology [8], rescue arm robot on basis of android [9], versatile prosthetic borewell scheme[10] etc.

From the earlier papers, it is clear that the progress that has been made in the automation industry with the aid of mechanical design has left a lasting effect on the society. Many researches solely aimed at the design to regulate the functioning of the bore well inside which the child is being trapped along with alerting the paramedical team and also by providing assistance to the victim in the process of the rescue. They also depicted the oxygen level, humidity point, pressure level along with the presence of toxic gases within the bore well and the nature of the soil. Adding to it, there is an atmospheric difference in the bore well as per the geographical positioning and the soil's nature. As the aforementioned methods might seem to be costly as well as demanding, the current paper deals with three possible as well as simple modes to save the child at a shorter time span. Thus, the main goal of the project is to aid and rescue the child from the bore well by making use of three modes such as supportive mechanism, inspection and holding. Raj et al. (2014), rescue approach that uses a pneumatic arm has been introduced for effective rescue. In order to rescue the child securely, the robot has been fastened with a harness. Nevertheless, fixing the harness to the child is not possible in a small hole for the pick-up procedure. The research of Gopinath and Devika [4] used the Solid works software to create a robotic arm which can perform various functions for the rescue from the bore well. Nevertheless, the design has not been implemented in practice to illustrate the feasibility of the anticipated solution.

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as demanding, the current paper deals with three possible as well as simple modes to save the child at a shorter time span. Thus, the main goal of the project is to aid and rescue the child from the bore well by making use of three modes such as supportive mechanism, inspection and holding.

2. METHODS AND MATERIALS

The rescue process of fallen babies in bore wells is difficult hence this paper designed ways as simple and highly effective.

A. Design

Modeling in creo2.0 parametric

In order for the cup to hold the baby a revolve command is utilized.

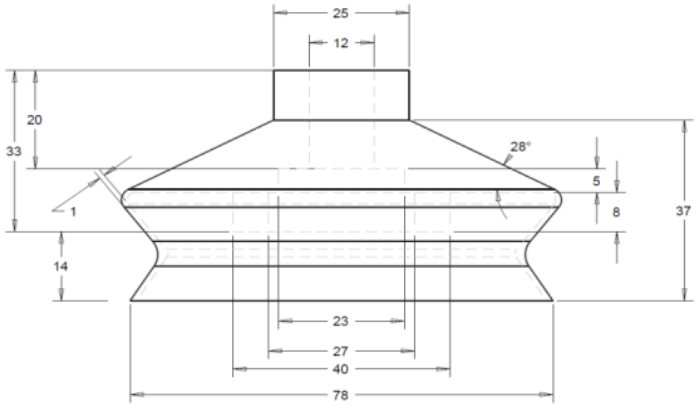


Figure 2.Represent the design used for developing holding mechanism.

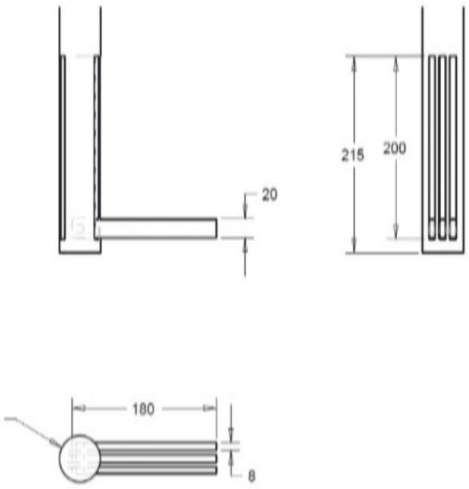


Figure 3. Represent the design used for developing supporting mechanism.

For developing the nut, helical sweep and revolve operation is put to use along with it, a pipe of 20 feet has been made with extrude operation. All the three parts are put together in the below given design.

B. Working Mechanism

This method simply persuades three mechanisms such as inspection mechanism, holding and adjustment mechanism and supporting and pulling mechanism.

1. *Inspection Mechanism:*

There are certain tools which might aid the process; they are night vision camera, oxygen pipe with an oxygen cylinder and a camera with torchlight. There might be issues like limited oxygen at deep levels of the bore wells which might suffocate the baby and might lead to its early death. Therefore, to avoid such situations a pipe with an oxygen cylinder might come handy. It is also necessary to comprehend the position of the baby. It must be known whether the baby in the bore well is in an inverted position with the legs upwards or in a normal position with its head upwards. It is also necessary to understand if there are any gap amidst the baby and the wall of the bore well. As the bore is very deep, there might be certain difficulties in the light to reach inside the well and might not provide a clear sight. It is mainly for these situations that a camera with a light or vision camera might come handy. At first, an oxygen pipe with a night vision camera or even torchlight was sent through the bore well close to the baby with the aid of the camera. The oxygen pipe might provide oxygen to the baby while the camera might aid in discovering the position of the baby.

2. *Holding and Adjustment Mechanism:*

There is a vacuum pipe that is connected to the end of the suction cap to aid the mechanism. If in case the baby stuck in the bore well is not is a favourable position, then it will be hard to pass the pass therefore, this suction cup will aid in creating the desired amount of gap so as to make it possible for the pipe to enter. This will be done by adjusting the position of the baby that is stuck inside the well. The vacuum pump builds the suction in the suction cup as it holds the baby and also alters the position of the baby to make a gap. This will aid the rode to enter inside the bore well.

3. *Supporting Mechanism:*

The equipment was made to be like a supporting rod which has three rods fixed to the end with a cloth. The supporting rod functions as an aid in holding the three rods which creates a supporting plate by pulling the rubber bush in the rod. These three rods will enact like a supporting plate which will hold a baby. The baby is covered by the protection of the cloth. As a baby is fallen into a bore well in general the baby keeps falling deeper into the well until the diameter or the size of the well gets smaller than the size of the baby. There are chances for the baby to go further deep if the baby moves or wiggles at its stuck position. Almost all the rescue machines are sent with a base so as to hold and lift the baby. It also means that the plate has tomovethrough the gap in between of the bore well and the baby. This might also not happen every time, as if at all there was a gap between the baby and the bore well there are more chances for the baby to slide deeper into it. The suction cup can create a space for ease passing of the supporting rod. The rod might pass through the gap and below the baby in the well the rubber

bush might be pulling with the supporting plate under the baby and the clothing covering it. Later, by pulling off the rod the baby might come up safely.

C. Fabrication details

The images of the three mechanisms were given below

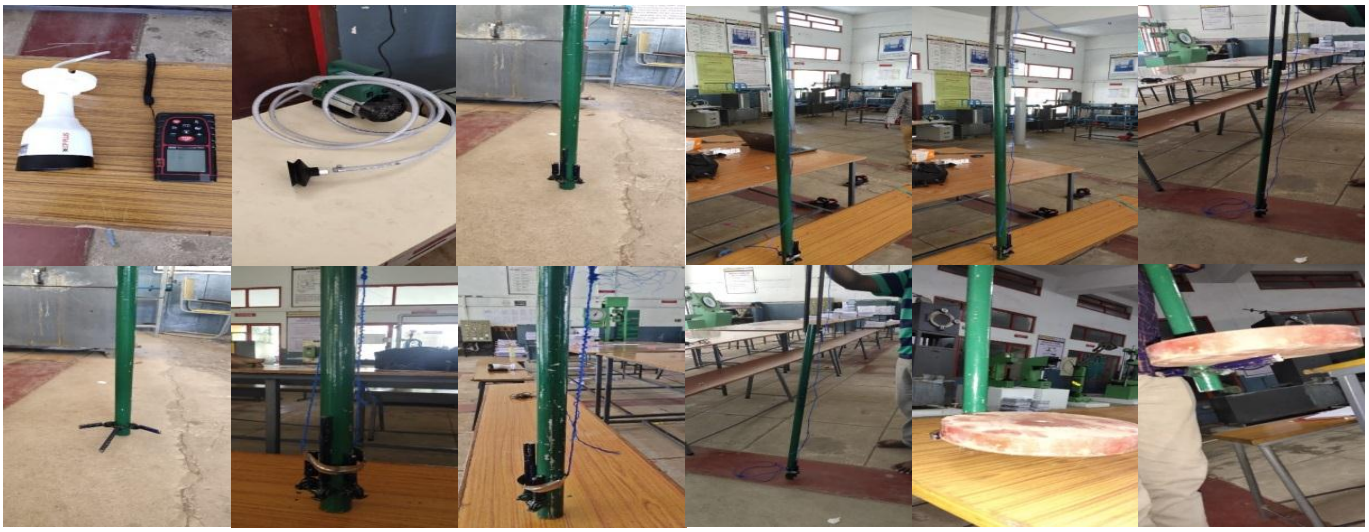


Figure 4. Fabrication of inspection, holding & supporting mechanism.

4. 3. RESULTS AND DISCUSSION

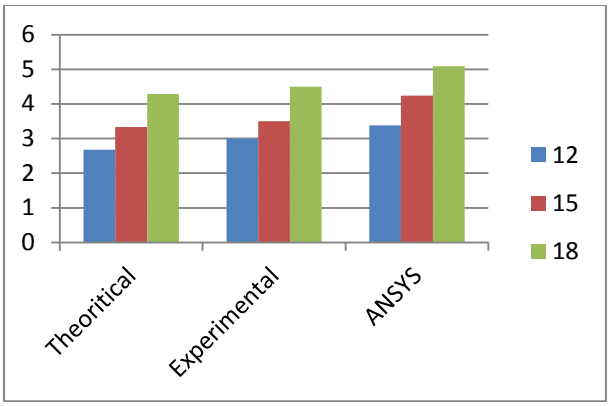
A. Holding Mechanisms

Table1. Comparison of outcome's for holding mechanism at different loads.

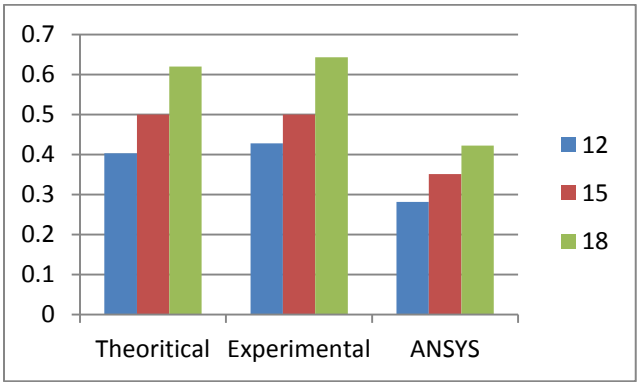
Load (kg)	**Deformation (mm)**			**Stress (MPa)**			**Strain**		
	Theoretical	Experimental	ANSYS	Theoretical	Experimental	ANSYS	Theoretical	Experimental	ANSYS
12	2.68	3	3.38	0.403	0.4275	0.281	0.134	0.1425	0.141
15	3.332	3.5	4.239	0.5	0.5	0.351	0.1666	0.16	0.17
18	4.284	4.5	5.086	0.62	0.6428	0.422	0.206	0.2142	0.2086

The above table presents the findings of holding mechanism method through three ways of calculation, i.e theoretical, experimental and ANSYS. The analysis was done at three different cases of children's weight at 12kg, 15 kg and 18 kg. In this regard, the study identified the deformation of 12 kg child in the aspects of theoretical, experimental and ANSYS at 2.68, 3 and 3.38 mm. The stress and strain was also noted at 0.403, 0.4275 and 0.281 MPa as well as 0.134, 0.1425 and 0.141 respectively. With regards to 15kg child, 0.141the deformation was 3.332, 3.5 and 4.239 mm. The stress and strain was also noted at 0.5, 0.5and 0.351 MPa as well as 0.1666,

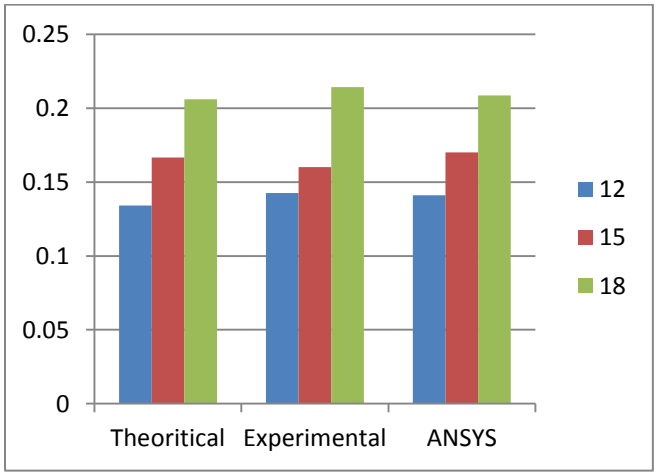
0.16 and 0.17 respectively. The deformation of 18kg child was 4.284, 4.5 and 5.086 in mm, stress was noted at 0.62,0.6428 and 0.422 MPa and strain are 0.206, 0.2142 and 0.2086.



Graph 1: Deformation



Graph 2: Stress



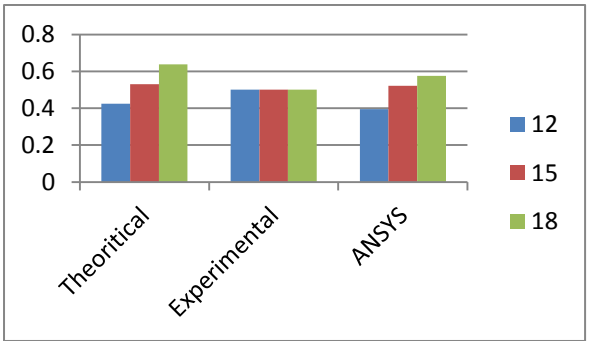
Graph 3: Strain

B. Supporting Mechanisms

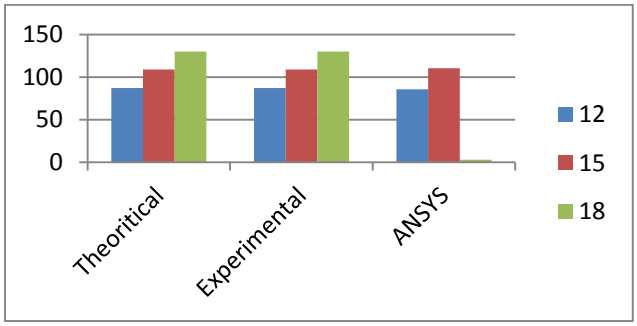
Table2. Comparison of outcome's for supporting mechanism at different loads.

	Deformation (mm)			**Stress (MPa)**			**Strain**		
	Theoretical	Experimental	Ansys	Theoretical	Experimental	Ansys	Theoretical	Experimental	Ansys
12	0.425	0.5	0.3957	87.2	87.2	85.73	1.2×10^{-6}	1.2×10^{-6}	1.24×10^{-6}
15	0.531	0.5	0.5216	109	109	110.23	1.5×10^{-6}	1.5×10^{-6}	1.52×10^{-6}
18	0.637	0.5	0.5756	130	130	129.82	1.8×10^{-6}	1.8×10^{-6}	1.81×10^{-6}

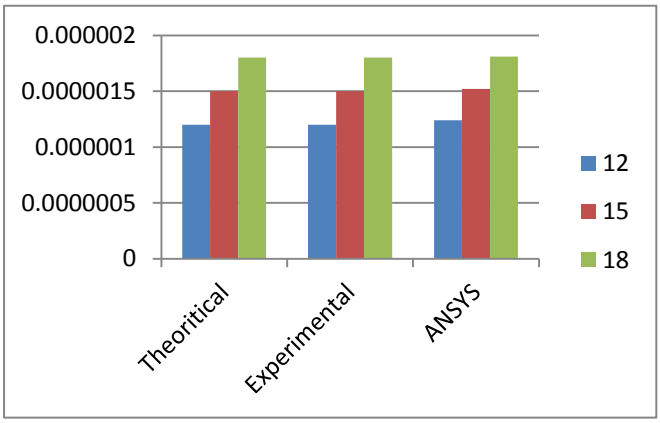
The above table presents the findings of supporting mechanism through three ways of calculation, i.e theoretical, experimental and ANSYS. These analyses were done at three different cases of children's weight. In this regard, the study identified the deformation of 12 kg child have 0.425, 0.5 and 0.3957 mm. The stress and strain was noted at 87.2, 87.2 85.73 as well as 1.2×10-6 in three calculations respectively. The deformation value of 15kg child was observed for theoretical, experimental and ANSYS are at 0.531, 0.5 and 0.5216, the stress value of three calculations are 109,109 and 110.23 MPa and strain are at 1.5×10-6, 1.5×10-6 and 1.52×10-6. Similarly, the deformation value of 18kg child was noticed for theoretical, experimental and ANSYS are at 0.637, 0.5 and 0.5756, the stress value of three calculations are 130,130 and 129.82 MPa and strain are at 1.8×10-6, 1.8×10-6 and 1.81×10-6 respectively.



Graph 4: Deformation



Graph 5 : Stress



Graph 6: Strain

5. DISCUSSION

The main aim of this present study is to design and investigate the effect of proposed bore well device with the help of three different mechanisms such as inspection, holding and supportive mechanism. The reason for doing this research is because of increasing the number of cases of bore-well accidents in India and moreover, there is no simple and effective technique to rescue the child from bore well accidents in the past two decades. Even though the existing techniques are effective, thus all are costly. Hence it is necessary to design the bore-well system that is acceptable for all individuals, i.e. for both rural and urban areas.

According to Manjari et al. [1], the bore-well accidents in India is higher subsequently from 2006. There are lot of techniques was adopted for rescue child in opened bore-well which include digital signals data (ADE), microcontroller, LED display, DC monitor, liquid crystals and crystalloids dot matrix along with robotic arm. Bore-well child rescue robot based on LabView was outlined and executed by Sujatha et al. [7], rescue robot based on IR technology was developed by Kalavathi et al. [8], android-based rescue arm robot was developed by [9], functional artificial limbs bore-well system was developed by Rajesh et al. [10]. But, these materials needed high manpower, huge electronic power and financial expenses. Therefore the present study designed the device with three distinct mechanisms in simple and efficient way. This study designed the device was based on the weight of the child such as 12kg, 15kg and 18kg through the theoretical, experimental and ANSYS calculations. In this aspect, deformation,

stress and strain was measured. It is very clear from holding and supportive mechanism findings, the deformation; stress and strain was designed on the basis of weight of the child. On the other hand, the device design also pointed out the method is time and money constraints. There are some earlier methods like wireless sensor fusion system designed by Sridhar et al. [6] to determine the external and internal state of the bore well. Using regulated power a sensor is mounted to a micro-controller. The information gathered from the bore well signal will be collected by using the transmitter RS 485, which is installed within the bore well. The RS 232 device will be used to collect incoming signal from the well. Different aspects such as temperature, CO, moisture, oxygen and many others have been measured. Our device design also covers all the mentioned facilities along with suction pump and cap size was designed with regards to weight of the child. The only constraint existing in the system was the amount of oxygen to chemically polluted soils which could give rise to reactions. This interaction could also create dangerous gases inside the bore-well which could cause damage or danger to the infant inside the bore-well.

The current method, that includes digging a perpendicular tunnel to save the infant beside the well wherein the infant has been stuck, currently [11]. Furthermore, it requires a lot of energy and costly materials that are not readily accessible throughout, and in this method, we still require a huge amount of space across the stuck bore to create a perpendicular bore. Such ad hoc techniques pose significant dangers, such as the likelihood of damage to the individual's body in the rescue effort. In many of these circumstances, we depend on some of them to make shift configurations. This does not convince us of long-term solution. Many kinds of hooks are used in these procedures to secure the patient's garments and body. This can lead to injury to the individual's body.

The present layout of the well-bore child-saving device has been tailored to accommodate almost any potential scenario in the rescue effort. This research likes to reach the conclusion with the assistance of our design that we can rescue without any harm.

6. CONCLUSION

In the past few years, there is an increasing children’s death rate due to bore well accidents. To avoid this, there are several rescue methods was identified by numerous people. Specifically the use of robots was increasing because of its higher success rate. But this method would take time and money, hence this paper use three different mechanisms include holding, inspection and supportive to rescue the bore well child within short period of time with proper theoretical and experimental calculations. Significantly, this paper consider three different cases of weight of children like 12kg, 15kg and 18kg based on which the device was designed and presented via images. The device was designed with the help of night vision camera with torchlight, oxygen pipe with an oxygen cylinder, vacuum pipe, suction cup etc. All these materials used were simple and effective and therefore it would help the rescue of child in both rural and urban areas at cheaper cost. This method would further definitely support the rescue paramedical and operation team efficiently.

7. FUTURE SCOPE

In the future, this project can be used in many other applications by providing extra elements to this project. The structure is formed formidable enough to support all probable loads, although it can be adaptable at the same time to develop the broader variety of bore diameter as well as any change in bore diameter.

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