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Bore well Rescue Robot

K.Arunkumar1*, K.S.Selvakumar2, K.Sriguna3, K.Subash4.

1* Assistant Professor, Dept. of Mechanical Engineering Sri Ramakrishna Engineering College, Coimbatore, India

2.Final Year Student ,Dept. of Mechanical Engineering, Sri Ramakrishna Engineering College, Coimbatore, India,

3.Final Year Student ,Dept. of Mechanical Engineering, Sri Ramakrishna Engineering College, Coimbatore, India

3.Final Year Student ,Dept. of Mechanical Engineering, Sri Ramakrishna Engineering College, Coimbatore, India,

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Abstract

The project is used to rescue the child which fell down into the bore well hole. The children having the age of 2 to 4 years who were playing near the open bore well may fall into the dig. We consider the children at this age for the design of this project. The robot is designed in such a way that it accommodates the size of the child and the bore well. The bore well hole in which the child would fall is at the major diameter of 12 inch. In present method we have to dig a well parallel to the bore well hole to reach the position of the child. Then a man will be sent through the well to rescue the child from the hole. Normally it takes eight to twelve hours for the rescue operation. In this method we have to spend too much of money and time for the rescue operation and moreover the life of the child is not assured. Since the present procedure is a tedious and a time consuming one, there is a need to have a robot which safely lifts the child from the bore well hole at faster rate. In order to overcome these difficulties in the present method we are going to design and fabricate the portable robot using simple mechanical components to lift the child.

Keys— *mechanical limit switch, rack and pinion*

INTRODUCTION

The main objective of this work is to rescue the child which has fallen into the bore well hole without noticing it. Since the present procedure is a tedious and a time consuming one, there is a need to have a robot which safely lift the child from the bore well hole at faster rate.

The main objectives this robot is:

To construct a robot having four sets of legs on which are placed at an angle of 90^0 in between each other. Among the four arms two arms acts as gripper to hold the child while the other two acts as backup arms To make it adaptive according to the dimensions of borehole (8-12 inches diameter).

To add grippers which are capable of moving in the horizontal direction so that it is able to hold the child

To add a rack and pinion setup to move the gripper arm to hold the child

To add a limit switches in order to switch on and off the motor for the movement of the gripper

Difficulties in present procedure are

It takes up to 30 hours to dig the parallel pit, by the time the child would have died

Lack of oxygen inside the bore well

Lack of visualization causes the major difficulty during the rescue operation.

There is no such equipment for rescuing the child which had fallen into the bore well.

A **LITERATURE SURVEY**

Palwinder Kaur ,Ravinder Kaur, Gurpreet Singh made an autonomous robot having self moving and self sustaining capacity. Wheeled leg mechanism is employed in this design to go inside the pipe. The legs are circumferentially and symmetrically spaced out 120 apart. LM-35 Temperature Sensor and 16X2 LCD are interfaced with PIC 16F877A microcontroller to sense the temperature inside the bore well and to display it respectively.

K.Saran,S.vignesh,Marlon jones Louis have done a human controlled computerized machine to rescue the child by using servo motors to hold the child and the safety balloons are used beneath the child to provide an additional safety to the child. This project includes series of process development from hand drawn sketches to computer generated design hon jose pattery , Jittu Varghese Kurian , Noble K John have done a prototype consists of four mechanisms driven separately . The motor placed at the top turns a gear mechanism which, in turn, pushes 3 blocks arranged at 120 degrees from each other towards the side of the bore well.

B.Bharathi, B.Suchitha Samuel have done a wirelessly controlled robot using Zigbee technology and dc motor based gripper operation for robotic arm. This prototype uses PIC 16F877A microcontroller in the operation of rescuing the child. The robot is operated through PC using wireless Zigbee technology and using wireless camera we can view both audio and video on the TV.

G.Nithin, G.Gowtham, G.Venkatachalam, S.Narayanan has done a machine assembly that is supported by a cable wire and be controlled and supported by a gear assembly, a stand and all necessary accessories. The robot self-operating system starts with the given input into the well. The IR sensor place along with camera on the bottom will detect the distance of the victim from the ground. Then the rescue robot is going to fit in the bore well. Oxygen supply is provided through a special pipe arranged from the rescue robot. Palwinder Kaur designed a remote controlled robotic system to implement in dangerous and labour intensive tasks. Robot's physical design is based on the three sets of parallelogram wheeled leg mechanism that are circumferentially and symmetrically spaced out 120^{o} apart. This robot has Temperature Sensor and Smoke Sensor to measure the temperature and gaseous concentration around it respectively.

A. DESIGN OF COMPONENTS

A. Motor Specifications

The linear movement of the gripper is done by using a motor which rotates the pinion of the rack and pinion setup. The motor is switched ON when the limit switch touches the child head and it will be switched OFF when the rack moves to the specific position. The specification of the motor used is as follows,
Speed : 60rpm Torque : 10kg-cm Capacity :0.25HP

Force exerted on the rod can be calculated by using the relation,
Torque = Force x Radius 1000 = F x 80
F = 12.5 N

B. Calculation of frictional force
For the smooth movement of the rack, the friction force must be lesser than that of the calculated force. So it is necessary to calculate the friction force.

Friction force, f_t = friction co-efficient * normal force
$f_t = 0.46 * 12.5$ $f_t = 5.75$ N

Since the frictional force (f_t) is less than Normal force (F) the motion of the rack is not affected

C. Design of rack and pinion
Let the material used for the rack and pinion is mild steel which is having a tensile strength of

about 407 Mpa. Stress induced in the rack and pinion arrangement by applying the load can be found by using the relation,
Stress = Force / Area
The resultant value of the stress is less than the ultimate tensile strength of the mild steel i.e., 407 Mpa. Hence the design is safe.
[1] Calculating the design bending stress [σ_b]:

The tooth breakage is caused by fatigue due to
repeated bending stresses. Therefore, allowable stresses must be determined on the basis of endurance limit. The design bending stress of the pinion can be calculated by using the relation,
$[\sigma_{b}] = 1.4*k_{bl}*\sigma_{-1} / n*k_{\sigma}$ where, $[\sigma_b]$ = bending stress
σ_{-1} = endurance limit in reversed bending
n = factor of safety = 2.5
K_{bl} = Correction factor = 1
k_{σ} = fillet stress concentration factor
The endurance limit (σ_{-1}) can be calculated by using the realtion,
$\sigma_{-1} = 0.22 (\sigma_u + \sigma_Y) + 500$
where , σ_Y = yield stress σ_u = ultimate stress
yield stress $(\sigma_Y) = 0.5* \sigma_u$

F. Calculation of design contact stress [σ_{C}] :

Surface strength is proportional to the surface hardness. Therefore, allowable contact stress is obtained by multiplying the hardness number by suitable coefficients and life factors.

Contact stress $[\sigma_C] = C_B * HB * K_{cl}$
Where, C_B = co efficient depending on surface hardness
HB = brinell hardness number K_{cl}= life factor

G. Centre distance:
The centre distance can be calculated by using the relation,
Center distance, $a = (i + 1)\{ (0.74/ \sigma_C)^2 * E [M_t] / i*0.3 \}^{⅔}$

where, E = young's modulus = $2.15x10^5$ N/mm^2

3. PICTORIAL REPRESENTATION

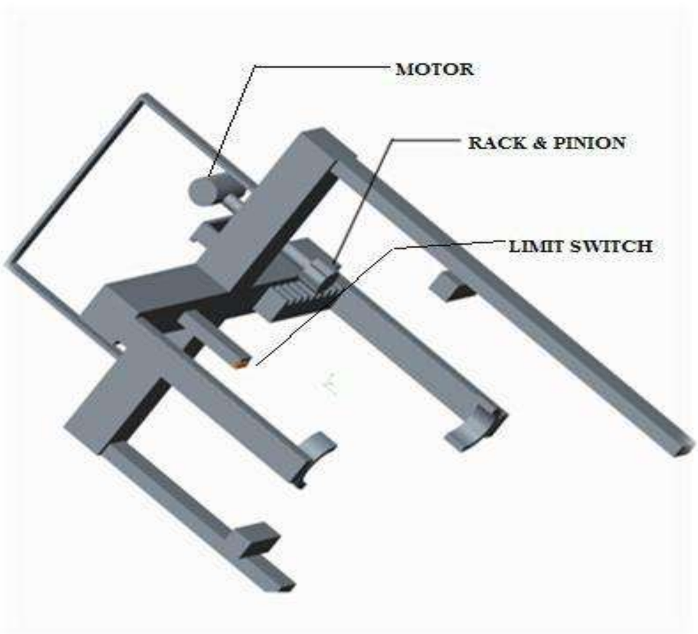
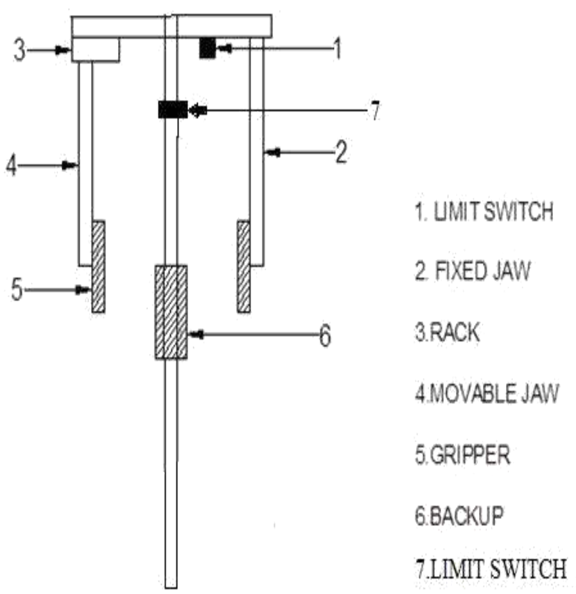


Fig.1 CAD model of recue robot

Fig.2 Sketch of rescue robot



4. EXPERIMENTAL TESTING ARRANGEMENT:

Fig.3 Experimental setup

This work consists of the following arrangement:

Mechanical Limit switch

Rack and Pinion Gear motor

The first step is to visualize the position of the child by lowering the CCD camera inside the bore well. Then fresh air is supplied to the child by means of a blower through hoses. After identifying the location of the child the robot is sent into the bore well by means of rope. For the stability of the robot inside the bore well hole, connecting pipes can be used instead of ropes.

The robot consists of four arms which are used to hold the child and to provide safety to the child. Three arms are of same length and one of the backup arm is of length quite lengthier than the other. It is designed in such a way by considering the height of the child. When the lengthier arm touches the ground, the holding positions of the two gripper arms will be at the shoulder height of the child. Thus it will not cause any harm to the child.

The gripper arm is attached to the rack of the rack and pinion setup. The robot also have two mechanical limit switches in which one is placed at the centre leaning downwards and the other limit switch is placed in a place straight to the rack . When the head of the child touches the limit switch the motor is switched on which in turn rotates the pinion of the rack and pinion arrangement. The linear movement of the rack makes the gripper arm to move in the same direction as it is attached to the rack. When the rack reaches a certain position it touches another limit switch which alternatively switches off the motor. The distance between the two gripper arms are designed in such a way that it does not over press or crush the child. Thus the child will be hold firmly by using these two gripper arms. The robot arm is designed and located in such a way that the gripper does not cause any damage to the child. The robot also consists of another two arms which act as a backup arm to prevent the child from falling downwards.

5. CONCLUSION

Thus by implementing this bore well rescue robot operated by a rack and pinion mechanism the child can be safely lifted upwards without causing any harm to the child. This robot is simple in construction and easy to operate and moreover it is a time saving method. The cost of this robot is comparatively lower than the other robot which has been existing. In future the robot can be improvised by adding the microcontroller to control the movement of the gripper.

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