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DESIGN AND DEVELOPMENT OF RESCUE SYSTEM FOR BOREWELL

A PROJECT REPORT

Submitted by

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In fulfillment for the award of the degree

of

BACHELOR OF TECHNOLOGY

IN

ELECTRICAL AND ELECTRONICS ENGINEERING

AMRITA SCHOOL OF ENGINEERING, BANGALORE

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BONAFIDE CERTIFICATE

This is to certify that the project report entitled "DESIGN AND DEVELOPMENT OF RESCUE SYSTEM FOR BOREWELL" submitted by

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in partial fulfillment of the requirements for the award of the **Degree - Bachelor of Technology** in " **ELECTRICAL AND ELECTRONICS ENGINEERING "** is a bonafide record of the work carried out under my(our) guidance and supervision at Amrita School of Engineering, Bangalore.

SIGNATURE	SIGNATURE
Mrs. M.Nithya	**Dr. Rashmi M. R.**
Assistant Professor	Chairperson
Department of EEE	Department of EEE

This project report was evaluated by us on……

EXAMINER 1	EXAMINER 2

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We offer our sincere pranams at the lotus feet of Universal guru, **MATA AMRITANANDA MAYI DEVI** who showered her blessings throughout this project.

We are gratefully indebted to thank**Br.Vishwamitra Chaitanya Swamiji, Director**, **Dr**. **Nagaraja S R, Principal** Amrita Vishwa Vidyapeetham, Bangalore for engraving a path for us to utilize the available resources to the fullest and thereby widen our perspective of education and growth through it.

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ABSTRACT

In the present scenario there have been several incidents reported on abandoned bore wells which are turning into death wells. Many children have been trapped into these bore wells and losing their lives. In several cases the rescue operations are done by digging the pits parallel to the existing one which is time consuming and needs a lot of manpower. In this case the chance of saving the child is very low. In order to overcome this issue, “Bore well rescue robot” is made. This robot is used to rescue the child from bore well. In this system a robotic arm is used for picking up the child. This gripper arm moves in accordance with the user commands given. Soft grippers are attached to the robotic arm to avoid injury for the child. Visualizing the child is made possible with the help of a camera. The hardware is interfaced to the PC and raspberry pi setup which is used to control the robot arm.

LIST OF FIGURES

LIST OF ABBREVIATIONS

Abbreviations	Definition
NASA	National Aeronautics and Space Administration
USB	Universal Serial Bus
LED	Light emitting diode
GPU	Graphics processing unit
CPU	Central processing unit
ARM	Advanced RISC Machine
GPIO	General-purpose input/output
LAN	Local area network
PWM	Pulse-width modulation
USART	Universal Synchronous/Asynchronous Receiver/Transmitter
EEPROM	Electrically erasable programmable read-only memory

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The major problem faced by human society today is water scarcity which leads to numerous borewells being sunk. These very borewells in turn became death traps and have taken innocent lives. Bores that yielded water, subsequently got depleted and are left uncovered. Young children who couldn't notice the uncovered pit fell into it and were trapped.

1.2 Background knowledge

In antiquity and in most of the Middle Ages, Robots were used for entertainment primarily. However, in the 20th century, there was a boom in the usage of industrial robots.Then, through the rest of that century, robots transformed society and facilitated safer conditions for labour. Additionally ,the implementation of advanced robots in the military and NASA has transformed the face of national defence and space exploration. Also, robots seemed to be influential in the media and advantageous for toy manufacturers. Robots are being designed efficiently using microcontrollers for fast working and to reduce human loss. There are different categories in the applications of the robot but the mechanical working is same in all the robots. There are three phases in the control of the robot. They are Perception, Processing and Action.The robots existing on the market can be classified depending on what they are able to handle and where they should operate. In general, the sensors that are mounted on the robot are preceptors. The processing is done by an on-board microcontroller . Then, the task is done with the help of motors or with some other actuators. Robot is designed to take the children out of the borewell with the use of grippers which are made to move with the help of motors.

1.3 EXISTING MECHANISM

In the current system, a large pit is dug alongside bore well up to the depth where the child is trapped. A little delay in the rescue process may drastically reduce the chances of a child's survival. By chance, if the area beside the bore pit gets rocky after a certain depth, then the chances of saving the child is very slim because it takes a lot of time to dig a parallel pit.

1.3.1 Drawbacks of existing mechanism

Due to the lack of oxygen and lack of light sources inside the bore well , things get difficult while rescuing the child. As there are no special equipment and rescue techniques to save the children during such disastrous accidents, many lives are lost due to incompetence . When the local resources do not work, we seek the army's help. In most reported cases so far, a hole is dug parallely and then a horizontal path is cleared in order to reach the child . This process is not only time consuming , but also risky due to various factors. Moreover this involves a lot of expensive resources and energy consumption making this process inefficient and moreover, we require big space around the target trapped bore so that we can dig. Despite the case , the success ratio depends on various factors like time taken for transportation of equipment to the rescue situation, human resources and mostly on the response time of related government organizations.

1.3.2 Proposed mechanism

The main objective of this project is to save a child safely who got struck in to the bore well without any injury .This is done by controlling a robot to rescue the child which is manually controlled by the person from outside.

Robotic arm is used for picking up the child from borewell pit which in turn is attached to soft grippers such that no injury due to the metal happens and grip will be present. Pi cam is used for video streaming, such that by seeing the position of the child, the arm movement is controlled manually. When the arm reaches the child, it is opened according to the position and width of the child. It is closed when it reaches the exact position where more grip is present and with the help of the gear motor the child is taken out.

1.4 CHAPTER ORGANIZATION

In **chapter1** we have discussed the traditional mechanism and its drawbacks and proposed mechanism is described.

In **chapter2** the literature survey done is explained in brief and concluded the way of approach for proposed mechanism.

In **chapter3** design and control of each part of the system is done and explained with appropriate diagrams.

In **chapter4** results of the hardware setup for the system is shown and explained.

In **chapter5** the conclusion of the project is done and its applications and future scope is discussed.

CHAPTER 2

LITERATURE SURVEY

2.1 INTRODUCTION

For the rescue operations for borewell many designed methods have been implemented by many people. But the main aim in this design is to overcome the drawbacks and make the robot work efficiently and effectively.

2.2 LITERATURE SURVEY

A wheeled leg mechanical setup is implemented in this design . The legs in the setup are circumferentially and symmetrically spread out 120 degrees apart. The robot is made adaptive and it's legs are adjusted according to the dimensions of the pipeline. This design structure makes it suitable to have the adaptation to the pipe diameter and to have adaptable attractive force towards the walls of pipe. During the rescue operation,movements of the child are captured using a USB Camera and monitored on PC. LM-35 Temperature Sensor is used to sense the temperature inside the bore well and the readings are displayed . This robotic structure is equipped with power supply, switch pad and gear motors. Adding a claw or gripper is a hurdle. Drawback is that they used a pi camera instead of a USB camera[1].

The robot uses embedded systems designing and zigbee communications for better communication. LED light and a camera are used to capture the child's movements as it helps to function the system by control unit. A vacuum cup is used to adjust the child's position. The arm movement of the setup is controlled using a stepper motor. Once the child is held safely by robot, BLDC motor helps to lift up the child from borewell.Also, ZigBee plays a vital role in data transfer between the victim inside the borewell and the recovery team above the pit. In this paper, Oxygen concentrator, safety balloon and CCTV camera to monitor on TV are added additionally.

Adding a pneumatic device (safety balloon) provides extra support for the victim. But, because of these additional elements , system complexity , size and cost of construction is increased[2].

The proposed model is designed to test various parameters like (humidity,carbon level ,speech ability, etc., inside the well at various stages of time and places by implementing wireless sensor fusion. This design helps the paramedics to give required treatment without any further delay after rescue.Currently, this model can only work upto 100 feet[3].

A robot is designed which is operated with the help of a PC using wireless Zigbee technology and with wireless cameras we can perceive both audio and video on the TV. High power LED is used in design which acts as a light source for when light intensity inside the pipe is less . This low cost robot used to observe the changes of different factors in the industrial pipes. The Microcontrollers used in the project are programmed with Embedded C language[4].

Arduino Uno microcontroller which is used to control the Ultrasonic sensor is used. This Ultrasonic sensor is used to measure the distance at which the victim is present and displays it on the LCD display in both meter and centimeter. The Rescue unit consists of two DC motors, a Web camera and a LED light. Web camera is connected with the PC to view the status of the victim inside the borewell. A motor driver (L293D) is used to drive two DC motors. One DC motor is used for the horizontal and vertical movement of the rescue unit and another DC motor is used for the open and close movement of the rescue unit. Thus our project is easily portable and less expensive which can be used in any situation to rescue the victim safely and also in less time. Arduino has less clock speed compared to Raspberry pi. In this model, sensors are not used. So, we cannot detect temperature levels[5].

2.3 SUMMARY

All these papers have given a detailed understanding regarding different designing techniques used in rescue operations. The design of the robot and robotic arm is also made. Using this literature survey, we found working principle, design and how to implement a designed machine in gripping and picking up the children. A different model is designed for the rescue operation. Temperature and pressure sensor and ultrasonic sensor are used to detect the child and using that temperature and pressure inside the borewell appropriate first aid is given so that the child is safe until he/she gets further treatment.

CHAPTER 3

DESIGN AND CONTROL OF THE SYSTEM

3.1 INTRODUCTION

A different model is designed for the rescue operation. Temperature and pressure sensor and ultrasonic sensor are used to detect the child and using that temperature and pressure inside the borewell appropriate first aid is given so that the child is safe until he/she gets further treatment. Using grippers, the child is held and use of soft materials are for the grippers so that the child does not get hurt while picking up.

3.2 IMPLEMENTATION DETAILS

Even though the appearance and capabilities of robots vary largely, all robots share a few mechanical features, movable structure with some control form. The Control of robots comprises three different phases namely:1.Perception 2.Processing 3.Action. In general, sensors(perceptors) are mounted on the robot,then processing is done by an on-board microcontroller or processor, and the task is completed using motors or with some other actuators. A Robot is designed to pick the trapped child in the borewells.

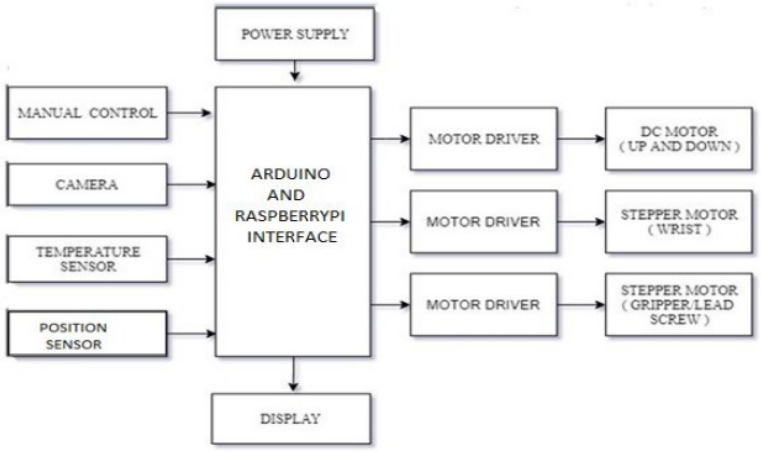

Fig.3.1 Block diagram

Figure 3.1 gives the brief idea of how the robotic system works. It is a complete block diagrammatic representation of the system.

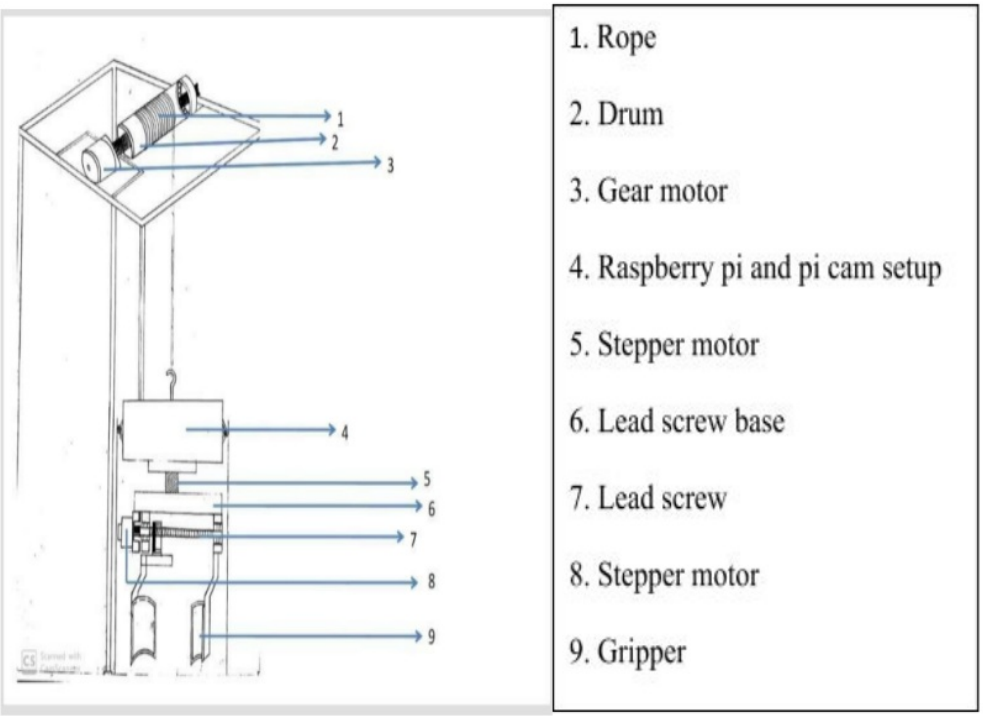

Fig.3.2 Reference diagram

Figure 3.2 is the imagined structure of the robotic arm(system) that is to be implemented further and parts of the system are labelled.

3.3 DESIGN OF COMPONENTS

3.3.1 GEAR MOTOR

Fig.3.3 Gear motor

Figure 3.3 is the gear motor used for high torque low speed applications. For the slow movement of rope upwards and downwards this motor is used.

We consider,

$$\text{mass of the arm} = 4kg(Max)$$

$$\text{radius of brake drum} = 6cm$$

$$Torque = Mgr/100$$

$$= 4*9.8*6/100$$

$$= 2.352 \text{ Nm.}$$

$$Speed(\omega) = 2 * 3.14 * N/60 \quad [2 * pi * N/60]$$

let us want

$N = 50\ rpm$

$\omega = 2 * 3.14 * 50/60$

$= 5.233$ radian/sec.

$Power = T * \omega$

$= 2.352*5.233$

$= 12.3088W.$

MARKET AVAILABILITY:

Torque in kg-cm available in market:

since

$Mass = 4kg$

$cm = 6cm$

$Torque = 6 * 4$

$= 24$kg-cm.

For this specifications, the model available in market is: ET-CGM95A-12100

whose Torque is 30kgcm.

voltage:

$Nominal = 12V$

$Operation\ range = 10 - 14V$

at no-load:

speed	=	100 *rpm*
current	<=	0.9

at rated speed:

speed	=	76*rpm*
current	<=	3.9*A*

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3.3.2 STEPPER MOTOR

A stepper motor, also known as step motor or stepping motor. It is a brushless DC electric motor .It divides a full rotation into a number of equal steps. Then,The motor's position can be ordered to move and hold at one of these steps despite using any position sensor. The motor should be carefully sized to the respective application considering torque and speed.

CALCULATIONS FOR SELECTING A STEPPER MOTOR

desired lead screw length= 18-23 cm.

desired screw diameter =8mm

$$Force = Sf + (load/2 * pi * (R/P) * Se$$

Where

P = *pitch of screw*

Se = *Screw efficiency* (0.2 *to* 0.4)

Sf = *static force* (*good* : $5N$ *to* $20N$ *range*)

$Load$ = *mass*

R = *Radius of screw*

FOR GENERALIZED CASE:

(Calculation will vary with the availability of product)

Sf = 20 (*worst case*)

$load$ = $2\,kg$ = $19.6\,N$ = $20N$

$Pitch$ = $2mm$ (*available in market*)

$Radius$ = $4mm$ (*available in market*)

Se = 0.2(*worst case*)

$Force$ = $20 + 20(2 * 3.14 * (0.004/0.002) * 0.2)$

$Torque = F * r$

$= 27.9617 * 0.004$

$= 0.11184\,N - m.$

$RPM\ of\ stepper\ motor = (a/360) * fz * 60$

where, a= step angle

f_z=pulse frequency in Hz.

Power of stepper motor:

$Power = T * \omega$

$$\omega = (2\pi N)/60$$

$$N = (a * fz * 60)/360$$

$$Fz = (\ inch/minute) * (step/inch) * (1\ minute/60\ sec)$$

For our requirement, we want the screw to travel 18cm in 4 sec.

$$(inch/minute) = 7.0866141\ inch/\ (4/60) minute$$

$$= 106.29921\ inch/min.$$

$$(step/revolution) = 360/(degree/step) = 360/(1.8)$$

$$= 200\ steps\ per\ revolution.$$

$$(step/inch) = (revolution/inch) * (1/microstep) * (step/revolution)\ of\ motor$$

$$= 5*200$$

$$= 1000\ steps\ per\ inch(neglecting\ microsteps)$$

$$Frequency = (106.29921 * 1000)/60$$

$$= 1.77165KHz.$$

This is the frequency of pulse which we need to provide.

Now,

$$rpm\ of\ motor = (a/360) * fz * 60$$

$$= (1.8/360)*1771.65*60$$

$$= 531.495\ rpm$$

$$Angular\ speed(\omega) = (2 * pi * N)/60$$

$$= 55.629\ rad/sec$$

$$Power = T * \omega$$

$$= 0.11184*55.629$$

$$= 6.22154 \text{ W}$$

3.3.3 GRIPS OF ARM

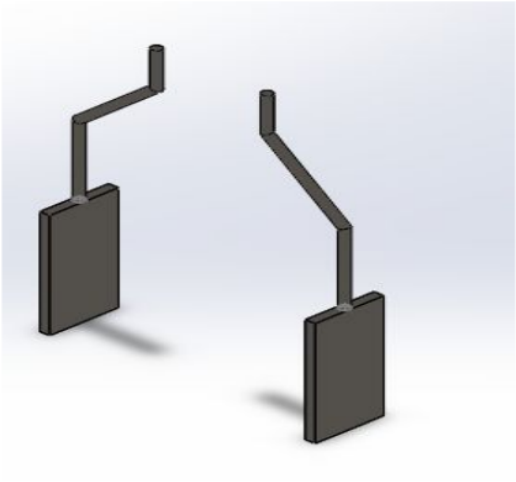

Fig.3.4 Arm grip

Figure 3.4 shows how the arms of the gripper look like and how its hands are extended.

Robotic arm is controlled through the commands given by the user from the monitoring station. This robotic arm is attached to the lead screw base. A robotic arm is a mechanical arm which is programmable with identical functions to a human.

There are two grippers attached on either side of the lead screw base. One is stationary and the other gripper is movable attached to the stepper motor throw lead screw.

Robots can do a lot of this work more efficiently than human beings because they are so precise. For example they always drill in the exact place commanded, and they tighten bolts with the commanded amount of force.

3.3.4 SOFT AND HIGH GRIPPING

3.3.4.1 DESCRIPTION

Soft robotic grippers play an important role in the tasks where the robotic grippers meet fragile objects. When compared with rigid grippers, soft robotic grippers are able to grip/manipulate various target objects. These robotic actuators can show a fast actuation at a low operating pressure. Grippers show the capability to hold objects from 80.99 g to 4.07g at 30-13 kPa.

3.3.4.2 MATERIALS USED FOR SOFT GRIPPING

It is seen that the robotic grippers assembled with RTV 225 and RTV 4503 silicone promise reliable gripping when compared to Elastosil M4600 silicone. It is observed that these low cost and fast actuation of low-pressure grippers have huge potential of application in the food industry, fruits industry in addition to daily life. Soft grippers are mostly used in today's robotics. This is one of the intelligent designs of gripping an object. Use of material which can grip the surface with large force is needed. There are two types of gripping materials used nowadays RTV 4503 and RTV 225.these both materials use silicone elastomers. Therefore we use silicon rubber sheets as soft material for grippers.

Fig.3.5 RTV4503 Gripper

Figure 3.5 is the type of soft gripper which uses a soft rubber material in it for the better grip and the material used is silicon rubber.

Fig.3.6 Silicone rubber sheet

Figure 3.6 is the silicon rubber that is used for better gripping which is attached to the gripper.

3.3.4.3 ADVANTAGES AND MARKET AVAILABILITY

Gripping pad with soft material uses silicon rubber as a soft material which will be placed in the gripping part of the arm for smooth gripping so that the child is safe and does not get hurt while lifting.

1. It has a high holding force so that the child cannot be slipped easily.
2. It has a very simplified structure and control over the object.
3. It is temperature resistant i.e It can withstand high temperatures.

Silicon rubber sheet is available in the market with following specifications:

1. Temperature resistance 50 to 250 degree C
2. Thickness 3.5 to 10.5 mm
3. Manufactured by India mart.

3.3.5 LEAD SCREW VS BALL SCREW

3.3.5.1 INTRODUCTION OF SCREWS

In motion automation applications these days, effective linear motion transfer systems such as lead screws and ball screws are demanded. Though lead screws are usually a less expensive alternative for ball screws, making a decision on the type of screw to be used is a lot more complex than focusing only on cost. While discussing ball screws vs lead screws, the striking difference is that a ball screw uses ball bearings to remove the friction between the nut and screw, but the lead screws do not. Leadscrews apply deeper helical threads with a mating nut, which is generally a product of polymer composite or bronze. The rolling nature of ball screws removes the sliding friction that comes with lead screws.

3.3.5.2 ADVANTAGES AND DISADVANTAGES OF LEAD SCREWS

Lead screws are available at less cost in the market. These are less cost effective in the long run due to maintenance costs. They do not require any breaking system as they are self locking. Due to this they have higher friction. Hence they require greater torque and larger motor and drive. Most lead screws are not well suited to high throughput, high speed applications or those systems with long cycle times and continuous run operation. As these are self lubricating they are less noisy and are preferred by many users.

Fig.3.7 Lead screw

3.3.5.3 ADVANTAGES AND DISADVANTAGES OF BALL SCREWS

Ball screws use ball bearings for the movement. They require braking systems and are more efficient and require less torque. They are accessible in higher accuracy grades for higher position accuracy. As they use ball bearings they have lower friction and can be run at lower temperatures. For better design life they require grease or oil lubrication. They have higher noise values hence is not preferred much. They even require breaking mechanisms to eliminate back driving. There is a chance of increasing and decreasing the preload.

Fig.3.8 Ball screw

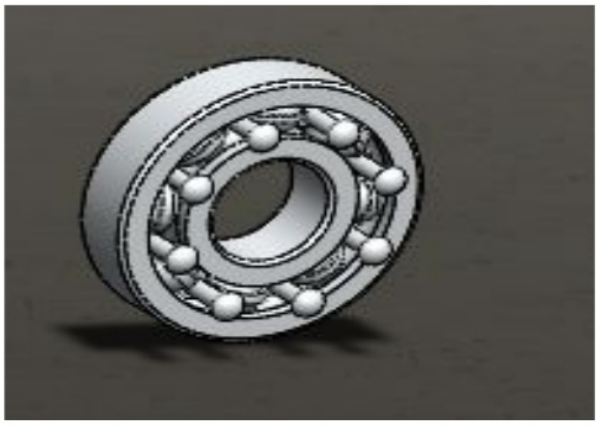

Fig.3.9 Ball bearings

3.3.6 LEAD SCREW BASE

The base of the lead screw is to hold the screw on either side such that it is made firm and stationary.

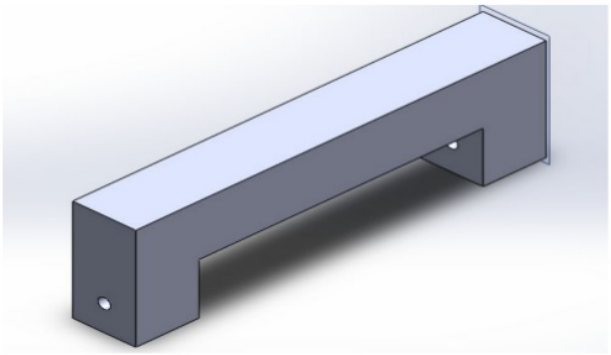

Fig.3.10 Lead screw base

3.3.7 DRUM

It is a pulley drum where the entire length of the rope is wounded and supported while dropping into the borewell.

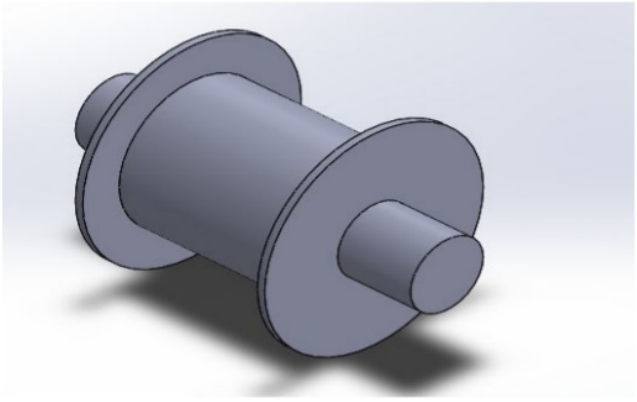

Fig.3.11 Drum

3.3.8 ULTRASONIC POSITION DETECTION

Using the ultrasonic sensor presence of the child is detected and it also gives distance from 2 cm to 400 cm. This detection is helpful so that the monitoring can be alerted when the obstacle is detected.

Fig.3.12 HC-SR04 Ultrasonic sensor

Figure3.12 HC-SR04 Ultrasonic Module has 4 pins namely:1.Ground 2.VCC 3.Trig and 4. Echo. The Ground pin and the VCC pin of the module are to be connected to the Ground and the 5 volts pins on the Arduino Board respectively and the trig and echo pins to any of the Digital I/O pin present on the Arduino Board.

3.3.9 TEMPERATURE AND PRESSURE SENSOR

We use a bmp180 sensor to detect temperature and pressure inside the bore well so that the child can get appropriate treatment after getting rescued from the borewell. this has a measuring range from 300 to 1100hPa. The accuracy is down to 0.02 hPa. It can also sense the altitude and temperature. The BMP180 barometric sensor communicates via I2C interface. This means that ,it communication is done with the Arduino with just 2 pins.

Fig.3.13 BMP 180 Temperature sensor

Figure3.13 bmp180 temperature and pressure Module has 4 pins, Ground, VCC, SCL and SDA. The Ground and the VCC pins of this module is needed to be connected with the Ground and the 5 volts pins on the Arduino Board respectively and the SCL and SDA pins to A5 and A4 pins on the Arduino Board respectively.

3.3.10 USB CAMERA VS PI CAMERA

The pi camera is connected directly to the GPU and it has the capacity of 1080p video encode. Because it is connected to the GPU there is only a low impact on the CPU, leaving it vacant for other processing.

Whereas the webcams (unless they have a built in encoding) don't get the same performance and they also use up a lot more CPU. Picture quality is usually better than webcams. Shutter speed is more for pi cameras than USB cameras.

Fig.3.14 PI Camera

Specifications of figure3.14 pi camera

- Resolution 5MP
- Camera serial interface(CSI) type
- 25x23x8 (LxWxH) mm are the dimensions of the camera
- 1080p @ 30fps, 720p @ 60fps these are the supported video formats

3.4 WORKING PRINCIPLE

The hardware prototype used for designing robots is Arduino UNO and raspberry pi. It is an open source prototype. Here there are two systems 1)sensing system 2)gripping system. In the sensing system we use BMP180 temperature and pressure sensor and ultrasonic sensor for position detection. These sensors are operated using arduino. There is also a gripping system attached to it which acts as a robotic arm.

Robotic arm is used for picking up the child from borewell pit which in turn is attached to soft grippers such that no injury due to the metal happens and grip will be present.Pi cam is used for video streaming, such that by seeing the position of the child, the arm movement is controlled manually. When the arm reaches the child, it is opened according to the position and width of the child.It is closed when it reaches the

exact position where more grip is present and with the help of the gear motor the child is taken out.

3.5 DESCRIPTION OF RASPBERRY PI

Raspberry Pi costs less and is a credit card sized computer that can be plugged into the computer monitor or to TV. This uses a standard keyboard and mouse. It is little but a very capable device that lets people of all age groups to know more about computing, and to explore program in languages like Scratch and Python .This capable of doing everything a desktop computer can do, from surfing the internet and playing a HD video, to making spreadsheets,and this also has the ability to interact with the outside world and has been used in a wide array of digital maker project, the below fig .3.1 depicts top view of Raspberry Pi 3b along with their GPIO pins.

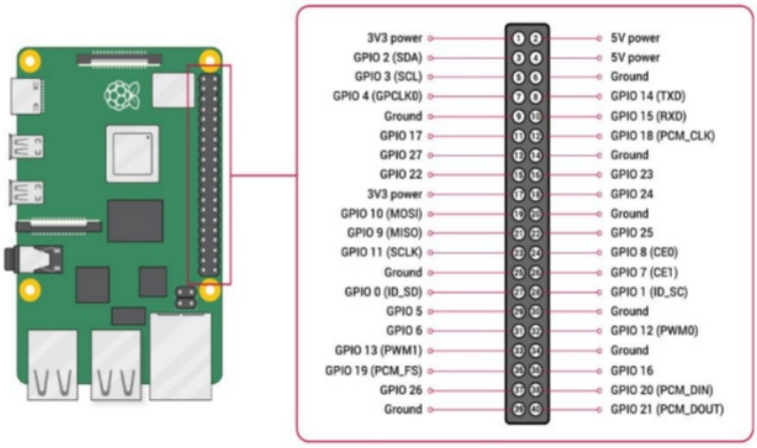

Fig.3.15 Pin diagram of Raspberry pi 3b

Technical Specification:

Processor:

Broadcom BCM2387 chipset.

1.2GHz Quad-Core ARM Cortex-A53 (64Bit)

Wireless LAN and Bluetooth 4.1 (Bluetooth Classic and LE):

IEEE 802.11 b / g / n Wi-Fi. Protocol: WEP, WPA WPA2, algorithms AES-CCMP (maximum key length of 256 bits), with the maximum range of 100 meters.

IEEE 802.15 Bluetooth, symmetric encryption algorithm Advanced Encryption Standard (AES) with 128-bit key, with the maximum range of 50 meters.

Memory:

1-GB LPDDR2

Operating System:

Boots from Micro SD card, running a version of the Linux operating system or Windows 10 IoT

Power:

Micro USB socket 5V, 2.5A

Connectors:

Ethernet 10/100 BaseT Ethernet socket

Video Output:

HDMI (rev 1.3 & 1.4)
Composite RCA (PAL and NTSC)

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Audio Output:

Audio Output 3.5mm jack

HDMI

GPIO Connector:

40-pin 2.54 mm (100 mil) expansion header: 2x20 strip

Providing 27 GPIO pins as well as +3.3 V, +5 V and GND supply lines

Memory Card Slot:

Push/pull Micro SDI

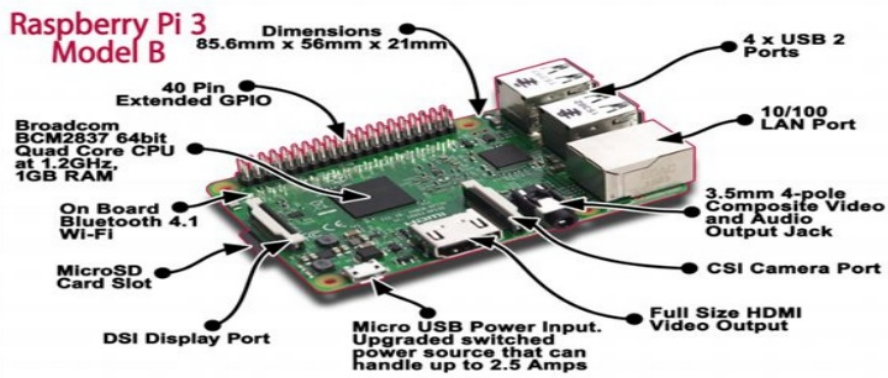

Fig.3.16 Raspberry pi model diagram

Table 3.1 Differences between all raspberry pi models

	Raspberry Pi 3 Model B	Raspberry Pi 2 Model B	Model B+	Model A+	Model A
Processor Chipset	Broadcom BCM2837 64Bit ARMv7 Quad Core Processor powered Single Board Computer running at 1250MHz	Broadcom BCM2836 32bit ARMv7 Quad Core Processor powered Single Board Computer running at 900MHz	Broadcom BCM2835 32bit ARMv6 SoC full HD multimedia applications processor	Broadcom BCM2835 32bit ARMv6 SoC full HD multimedia applications processor	Broadcom BCM2835 32bit ARMv6 SoC full HD multimedia applications processor
GPU	Videocore IV	Videocore IV	Videocore IV	Videocore IV	Videocore IV
Processor Speed	QUAD Core @1250 MHz	QUAD Core @900 MHz	Single Core @700 MHz	Single Core @700 MHz	Single Core @700 MHz
RAM	1GB SDRAM @ 400 MHz	1GB SDRAM @ 400 MHz	512 MB SDRAM @ 400 MHz	256 MB SDRAM @ 400 MHz	256 MB SDRAM @ 400 MHz
Storage	MicroSD	MicroSD	MicroSD	MicroSD	SDCard
USB 2.0	4x USB Ports	4x USB Ports	4x USB Ports	1x USB Port	1x USB Port
Power Draw / voltage	2.5A @ 5V	1.8A @ 5V	1.8A @ 5V	1.8A @ 5V	1.2A @ 5V
GPIO	40 pin	40 pin	40 pin	40 pin	26 pin
Ethernet Port	Yes	Yes	Yes	No	No
Wi-Fi	Built in	No	No	No	No
Bluetooth LE	Built in	No	No	No	No

3.6 DESCRIPTION ABOUT PROTEUS SOFTWARE

Proteus software tool is a design software tool used in designing electronic design schematics and also in manufacturing printed electronic boards. This is an application for layout designing, simulations printed circuit boards called PCB and schematic captures. This is the core component containing all details of the component or product used in the simulations or designs. Since it is reducing the hardware usage it can be used as a training tool for fresh learners in order to bring perfection in them and also as a teaching tool.

Here microcontroller simulation is used which works by taking a hex file or a debug file to the microcontroller part in the designed simulation or schematic. Co-simulation is carried along with the analog and digital electronics connected to it. It is broadly used in motor controlling and temperature control and user interface designing areas.

Microcontrollers of versions pic10,12,16,18,24 and 33. Arduino,8051,8056 and arm cortex m3 processors and many

3.7 DESCRIPTION OF PIC16F877A MICROCONTROLLER

This is easy-to-program and is powerful with 200 nanosecond instruction execution. There are only thirty five single word instructions. It has 256 bytes of EEPROM memory in it. It is self programming with two comparators and eight channels of ten bit analog to digital converter (A/D). To capture/compare/PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI) or the 2-wire Inter-Integrated Circuit (I2C) bus and a Universal Asynchronous Receiver Transmitter (USART).

Table 3.2 Detailed Features of PIC16F877A

PIC16F877A –Detailed Features	
CPU	8-bit PIC
Architecture	8
Program Memory Size (Kbytes)	14
RAM (bytes)	368
EEPROM/HEF	256/HEF
Pin Count	40
Max. CPU Speed (MHz)	20
Peripheral Pin select (PPS)	No
Internal Oscillator	No
No. Of comparators	2
No. Of Operational Amplifier	0
No. Of ADC channels	14

Max ADC Resolution (bits)	10
ADC with Computation	No
Number of DAC Converter	0
Max DAC resolution	0
Internal Voltage Reference	Yes
Zero Cross Detect	No
No. Of 8-bit timers	2
No. Of 16-bit Timers	1
Signal Measurement Timer	0
Hardware Limit Timer	0
No. Of PWM outputs	0
Max PWM resolution	10
Angular Timer	No
Math Accelerator	No
No. Of UART module	1
No. Of SPI Module	1
No. Of I2C module	1
No. Of USB Module	0
Windowed Watchdog Timer (WWDT)	No
CRC/Scan	No
Numerically Controlled Oscillator	0
Cap. Touch Channels	11

Segment LCD	0
Minimum Operating Temperature (*C)	-40
Maximum Operating Temperature (*C)	125
Minimum Operating Voltage (V)	2
Maximum Operating Voltage (V)	5.5
High Voltage Capable	No

APPLICATIONS

- Used in many DIY Projects
- Very good for learning PIC
- Projects that need Multiple I/O interfaces and communications
- Can be used as an alternative for Arduino Module
- Suitable for more complex level A/D applications in automotive industry, industrial, appliances and consumer applications.

3.8 SUMMARY

Chapter3 explains the implementation details of the sensing system and gripping system and its materials. The working principle of the whole sensing part of the robotic arm is discussed and implemented.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 INTRODUCTION

In this chapter, the hardware setup of the sensing system and its results are shown. Hereby, a design model is proposed as a borewell rescue robot which has the ability to rescue a child trapped inside a borewell pit. It can sense and display temperature as well as altitude.

4.2 SIMULATING THE DESIGN USING PROTEUS

The hardware has been implemented and the output of hardware is the same as the simulation output. The motion of the motors is controlled using a PIC based circuit in the proteus and a switch as shown in fig 4.1 and the code is written accordingly.

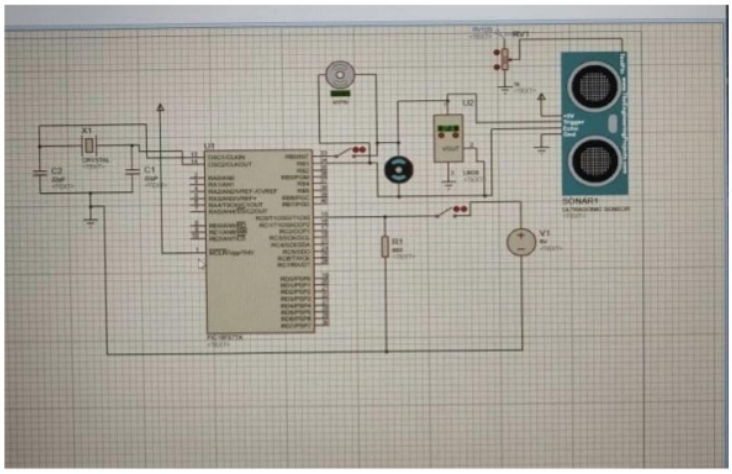

Fig.4.1 Simulation circuit of the proposed borewell system

Initially we give 0x01 to PORT B so that the DC motor rotates by sensing the bit in PORT C simultaneously.

The code is written in such a way that, when the switch is pressed, 0x02 is given to PORT B and this reverses the direction of the motor. And hence the motion of the motor is controlled.

4.3 RELATING THE SIMULATION TO THE HARDWARE MODEL

In the hardware model, Raspberry pi is used. Whereas in simulation, a pic microcontroller is used since the camera module is not designed. In both models, two motors are used. One is used to control the gripper motion and the other is to control the pulley action. In both hardware design and the simulation model, the ultrasonic sensor HC-SR04 detects the distance between the subject and the gripper and when the subject is close, a signal is sent for the gripper action .The pulley action is done manually. So, in the simulation model, the servo motor is activated using a switch. The working and the outputs of the simulation model is similar to the hardware model.

4.4 HARDWARE SETUP OF TEMPERATURE SENSOR

BMP180 temperature sensor detects temperature and pressure using an arduino as an interface.

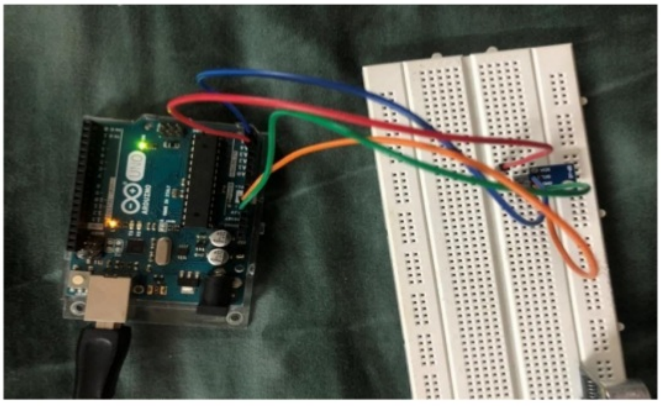

Fig.4.2 Temperature sensor

Fig 4.2 shows the hardware setup of the arduino connecting to the bmp180 sensor to measure the required parameters and the results are displayed in fig 4.3.

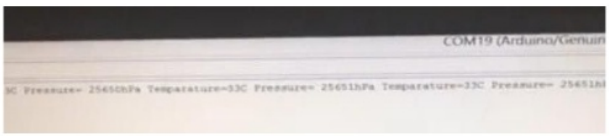

Fig.4.3 BMP 180 Output

Figure 4.3 shows the Pressure and temperature results of the circuit Fig.4.2

4.5 HARDWARE SETUP OF ULTRASONIC SENSOR

We detect the position and distance of the obstacle(child) present inside the borewell using IR reflections.

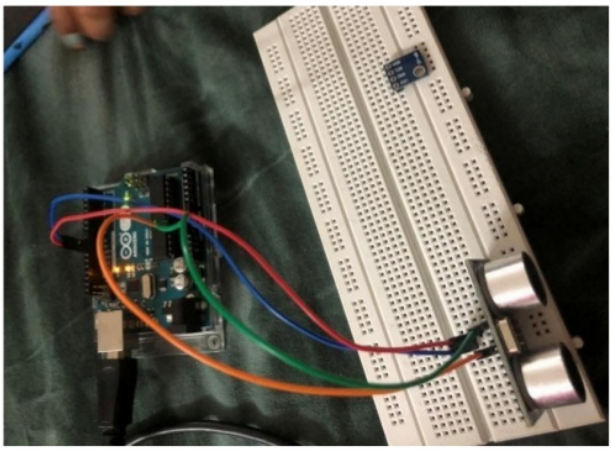

Fig.4.4 Hardware setup of Ultrasonic sensor

Figure 4.4 shows the hardware setup of the arduino connecting to the ultrasonic sensor to measure the required parameters and the results are displayed in figure 4.5.

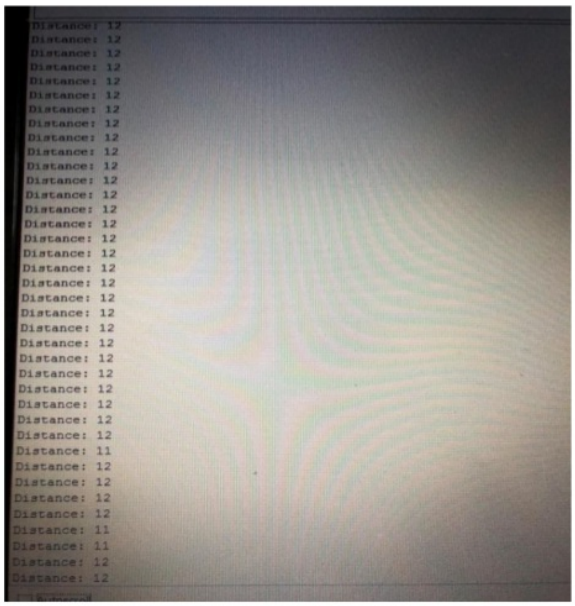

Fig.4.5 Results for Ultrasonic sensor circuit

Fig.4.5 are the results obtained for the HC-SR04 ultrasonic sensor which gave the distance output of the obstacle.

4.6 HARDWARE SETUP OF MOTOR

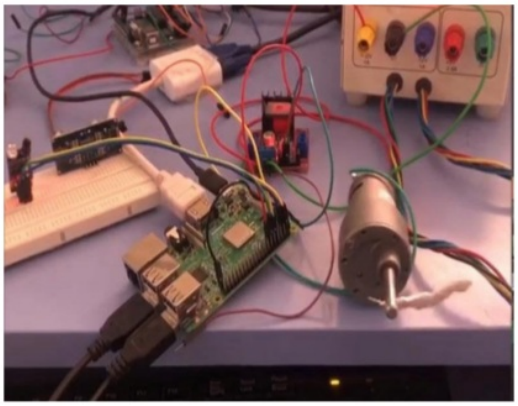

Fig.4.6 Hardware setup of Motor

From figure 4.6 it is said that the motor rotates which in turn helps with the gripper motion when the object is close by.

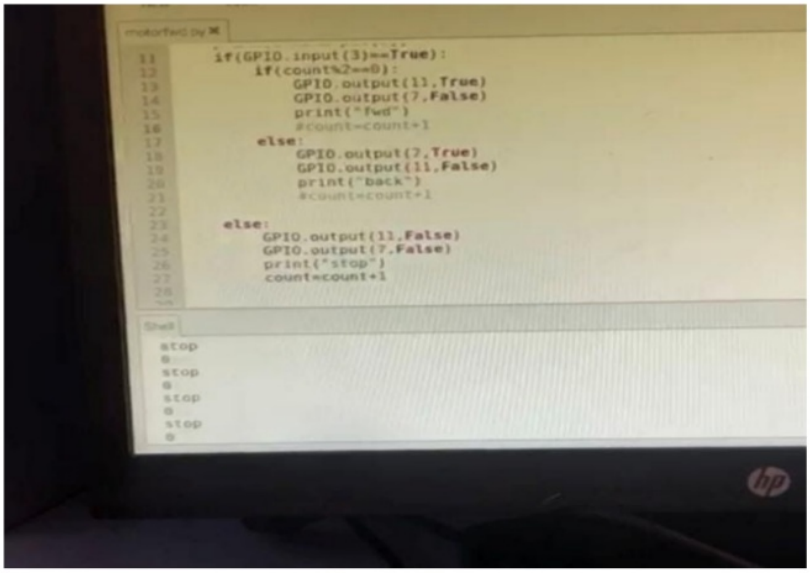

Fig.4.7 Simulation results for Motor

Fig.4.6 shows the hardware setup for the motor and Fig.4.7 shows the results obtained.

4.7 SUMMARY

This chapter shows the hardware setup of the sensing system and the gripping system . The working system is implemented and the results are shown in this chapter.

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 CONCLUSION

Here in this project we design a rescue robotic arm for the child in the borewell using arduino and pi interfaces. Grippers are made in convenience with the child to hold ,grip and take out from the pit. Sensing systems are used to give the child appropriate first aid after taking the child out thus it is made useful and cost efficient.These kinds of systems are used in picking up fruits and placing them in an accurate position, mainly in the food and fruit industry and also used in military purposes and crowded places. Nowadays these are mostly used in bomb detection and its safe diffusion.These are available at less cost and can be controlled very safely without any human loss. It also reduces man effort.

5.2 FUTURE SCOPE

This rescue design is highly efficient and requires less man power .The proposed system can overcome all the difficulties that we face while implementing the traditional method. With the help of this system, rescue operations are done less time as compared to traditional methods.This system is safer and the chances of the victim getting out safely are high . Thus, this model has been designed to avoid most of the obstacles that may arise during the rescue operation.

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