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Design and Fabrication of Pneumatic Borewell Child Rescue System

M. V. Ravi[1], Nehal Thakur[2], B. N. Rachana[3], S. Chandana[4*], R. Rakshitha[5]
[1]*Assistant Professor, Department of Electronics and Communication Engineering, SJC Institute of Technology, Chickballapur, India*
[2,3,4,5]*UG Student, Department of Electronics and Communication Engineering, SJC Institute of Technology, Chickballapur, India*
*Corresponding author: chandanas652@gmail.com

***Abstract*: Today's major problem faced by human society is water scarcity, which leads to many bore wells being digged. Bores which yielded water and afterwards got depleted are left uncovered. A suitably strong cap of bright colour to cover the mouth of bore will avoid such accidents. To aid in such rescue we have proposed a system. Methods to keep child alive in a bore should take in to consideration the lack of oxygen, increased temperature and humidity, which produces hyperthermia. These problems are addressed with fresh air delivery or without delivery of oxygen. The remotely controlled robot will go down the borewell and perform the action. The rescue system is operated through PC using wireless camera and Bluetooth technology.**

***Keywords*: Rescue, Wireless camera, Bluetooth.**

1. Introduction

In current framework, growing water scarcity is the major problem which people come across in a day to day life. Small children without spotting the hole dug for the bore-well slip in and get trapped. These accidents are mainly happened due to inattention or playful activities of the child. The occurrence of latest technique provides pragmatic opportunity for new robot power and awareness of new methods of control theory. The presented robot control system can be used for different enlightened robotic applications.

The bore wells are sometimes left open without any proper covering. The rescue operations in many cases are riskier even to the rescue team members. A small delay in this whole process may reduce the chances of saving the child. If the area near the bore hole contains rocks below certain depth, chances of saving the child becomes very less.

Whatever may be the case the rate of success depends on lot of factors like time taken for transportation of machinery to the situation, human resources and mainly the response time of various government organizations.

At present there is no proper method for dealing with this problem. The holes drugged for the bore wells are around 700 ft. deep. The child fall into open bore-wells and rescue operations was almost end with failure.

We are developing a robot machine that can take out the trapped body in a systematic way. It will also perform various lifesaving operations for the sufferers such as oxygen supply. It will be a light weight machine that will be setup easily into bore-well and hold the trapped body systematically.

2. Problem Statement

In today's era, it is possible to achieve all those targets which we humans cannot complete on our own. Thus, the motto of this proposed model is to design a system which performs the task of rescue of the victims trapped inside the bore well along with considering the preventive measures for the safety of the victim. The basic concept of this project is to bring the victim to ground without any injuries in a very short span. The system is provided with gripping capability based on pick and place concept and adaptability to the inner environment of the well. This is also provided with self- sustaining capability and sensing ability to sense the environmental factors (temperature, oxygen) around it.

The whole process is made wireless to remove complexity in wired systems. NRF technology is being implemented to capture all the information needed. A video camera to observe the actual situation closely and continuous interaction with the victim could also be possible. The whole operation is made effective by using the tele operation phenomenon between the system and the user. Thus, a system is designed that can take out the trapped body in systematic way. It will also perform various life-saving operations for the victims.

3. Block Diagram and Background

The entire overview of the system is shown in above figure. The major components are classified as lifting unit, control unit, sensing unit, gripper system, fail-safe system and graphical unit. The lifting unit comprises of a rope, pulley and a pole. The upward and descending movements of the mechanical framework are controlled by utilizing the pulley assembly and the motor.

The whole mechanical assembly is controlled from the portable workstation through the serial commands. The Arduino Atmega 328 controller is the heart of the framework

that controls the operation of sensors, furthermore, the DC motors are driven. Temperature sensor is utilized for detecting the temperature inside the well, gas sensor is utilized to gauge the level of harmful gasses, and ultrasonic sensor is utilized to quantify the correct separation between the rescue arm and the casualty.

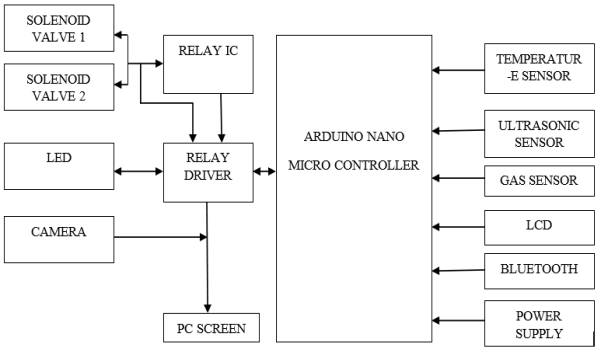

Fig. 1. Block Diagram

A. *Temperature Sensor*

It generates calibrated digital output. DHT11 can be interface with any microcontroller like Arduino, Raspberry Pi, etc. and get instantaneous results. DHT11 is a low-cost humidity and temperature sensor which provides high reliability and long-term stability. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and outputs a digital signal on the data pin (no analog input pins needed). It is very simple to use, and libraries and sample codes are available for Arduino and Raspberry Pi. This module makes is easy to connect the DHT11 sensor to an Arduino or microcontroller as includes the pull up resistor required to use the sensor. Only three connections are required to be made to use the sensor - Vcc, Gnd and Output. It has high reliability and excellent long-term stability, thanks to the exclusive digital signal acquisition technique and temperature & humidity sensing technology.

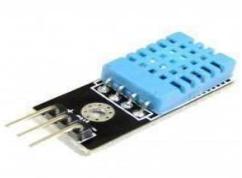

Fig. 2. DHT11 Temperature Sensor

B. *Ultrasonic Sensor*

Ultrasonic sensor is commonly used with both microcontroller and microprocessor platforms like Arduino, ARM, PIC, Raspberry Pie etc. The following guide is universally since it has to be followed irrespective of the type of computational device used. Power the Sensor using a regulated +5V through the V_{cc} and Ground pins of the sensor. The current consumed by pins of the microcontroller. To start the measurement, the trigger pin has to be made high for 10uS and then turned off. This action will trigger an ultrasonic wave at frequency of 40Hz from the transmitter and the receiver will wait for the wave to return. Once the wave is returned after it getting reflected by any object the Echo pin goes high for a particular amount of time which will be equal to the time taken for the wave to return back to the sensor. The amount of time during which the Echo pin stays high is measured by the MCU/MPU as it gives the information about the time taken for the wave to return back to the Sensor.

Fig. 3. Ultrasonic Sensor

C. *Gas Sensor*

Gas Sensor module for Air Quality having Digital as well as Analog output. Sensitive material of gas sensor is SnO2, which with lower conductivity in clean air. When the target combustible gas exists, the sensors conductivity is higher along with the gas concentration rising. gas sensor has high sensitivity to Ammonia, Sulphide and Benze steam, also sensitive to smoke and other harmful gases. It is with low cost and suitable for different application.

Fig. 4. Gas Sensor

D. *Wi-Fi Camera*

Extremely compact: All models are extremely compact. They can easily be integrated in a machine vision environment.

- Choice of image quality: The FLIR A65 produces crisp thermal images of 640 x 512 pixels. Users that do not need this high image quality for their application can choose for the FLIR A35 which produces thermal images of 320 x 256 pixels, for the FLIR A15 which produces thermal images of 160 x 128 pixels or for the FLIR A5 which produces thermal images of 80 x 64 pixels.
- GigE VisionTM standard compatibility: GigE Vision is a new camera interface standard developed using the Gigabit Ethernet communication protocol. GigE Vision is the first standard to allow for fast image transfer using low cost standard cables even over long distances. With GigE Vision, hardware and software from different vendors can interoperate seamlessly over GigE connections.

Fig. 5. Wi-Fi Camera

E. LCD

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly, instead using a back light or reflector to produce images in colour or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as pre-set words, digits, and seven-segment displays, as in a digital clock.

Fig. 6. LCD

F. Solenoid Valve

A solenoid valve is an electro mechanically operated valve. Solenoid valves differ in the characteristics of the electric current they use, the strength of the magnetic field they generate, the mechanism they use to regulate the fluid, and the type and characteristics of fluid they control. The mechanism varies from linear action, plunger-type actuators to pivoted-armature actuators and rocker actuators. The valve can use a two-port design to regulate a flow or use a three or more port design to switch flows between ports. Multiple solenoid valves can be placed together on a manifold.

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design.

Fig. 7. Solenoid Valves

G. Relay Driver and Relay IC

A Relay driver IC is an electro-magnetic switch that will be used whenever we want to use a low voltage circuit which is connected to 220V mains supply. The required current to run the relay coil is more than can be supplied by various integrated circuits like Op-Amp, etc.

Relay have been around for a long time, they have unique properties that make them more robust than solid-state devices and are not going away. The unique properties are high current capacity, ability to withstand ESD and drive circuit isolation.

There are numerous ways to drive relays. In preparation for some of the more advanced relay drivers I will be posting in the future, I have listed a few basic relay drivers for your reference. Included are the following: High side toggle switch driver, low side toggle switch driver, bipolar NPN transistor driver, Darlington transistor driver, N-Channel MOSFET driver, and ULN2003 driver.

Fig. 8. Relay Driver and Relay IC

H. Pneumatic Cylinder

Pneumatic cylinder(s) (sometimes known as air cylinders) are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion. [1]

Like hydraulic cylinders, something forces a piston to move in the desired direction. The piston is a disc or cylinder, and the piston rod transfers the force it develops to the object to be moved. Engineers sometimes prefer to use pneumatics because they are quieter, cleaner, and do not require large amounts of space for fluid storage.

Because the operating fluid is a gas, leakage from a pneumatic cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement.

Fig. 9. Pneumatic Cylinder

I. Arduino Nano

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P; offers the same connectivity and specs of the UNO board in a smaller form factor. The Arduino Nano is programmed using the Arduino Software (IDE).

Arduino Nano comes with a crystal oscillator of frequency 16 MHz. It is used to produce a clock of precise frequency using constant voltage. There is one limitation using Arduino Nano i.e. it doesn't come with DC power jack, means you cannot supply external power source through a battery.

J. Embedded C

Embedded C is most popular programming language in software field for developing electronic gadgets. Each processor used in electronic system is associated with embedded software.

Embedded C Programming is the soul of the processor functioning inside each and every embedded system we come

across in our daily life, such as mobile phone, washing machine, and digital camera. Each processor is associated with an embedded software.

The first and foremost thing is the embedded software that decides functioning of the embedded system. Embedded C language is most frequently used to program the microcontroller.

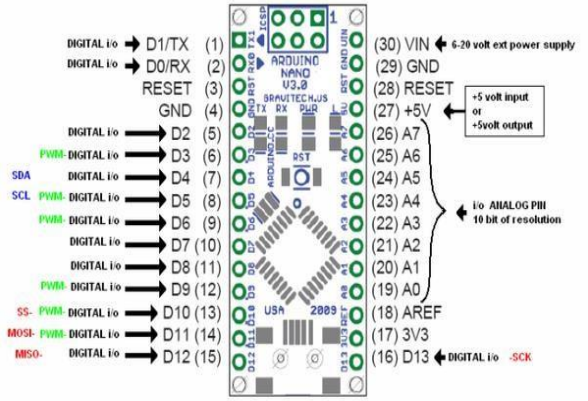

Fig. 10. Arduino Nano

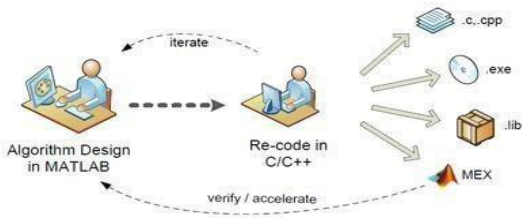

Fig. 11. Embedded C

K. Arduino IDE

The Arduino Integrated Development Environment (IDE) is across-platform application that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards.

The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware. By default, avrdude is used as the uploading tool to flash the user code onto official Arduino boards.

In October 2019 the Arduino organization began providing early access to a new Arduino Pro IDE with debugging and other advanced features.

4. Applications and Advantages

A. Applications

1) As Borewell rescue system

As described the model is used as bore well rescue system. i.e., it is used to prevent the child falling into the bore well with some additional sensors and alarms that will be very useful in the rural areas.

2) Temperature and Gas sensing in the earth's crust

Since the temperature in the earth's crust will be very high, no human can go to test the gases and minerals which are required. Hence robots are used in such cases as substitute. For example, for the testing of Zno (Zinc Oxide).

3) To take Images and Communicate in mining field

The model will be used in the mining fields to avoid the human deaths since because the machines which will be using in the mining fields are automated and they may cause harm to the human beings and since the gases liberated during the process are harmful to the human health so to avoid all these risks model is used as substitute of human for all the working purposes in the fields of mining.

B. Advantages

- Low cost as compared to the army rescue methods.
- Light weight but sufficiently strong to carry a victim of up to 15 kilograms.
- Completely automatic but accordingly controlled by human.
- Less human resource requirement.
- Safer enough to rescue a victim with minimum injuries**.**

5. Results

The result of the topic is show below.

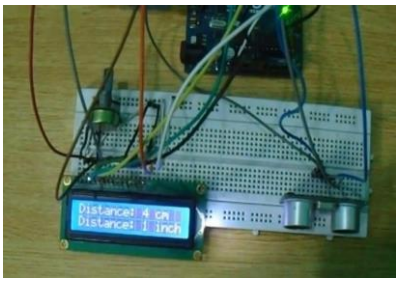

Fig. 12. Reading of Ultrasonic Sensor

Fig. 13. Pneumatic Module with arms

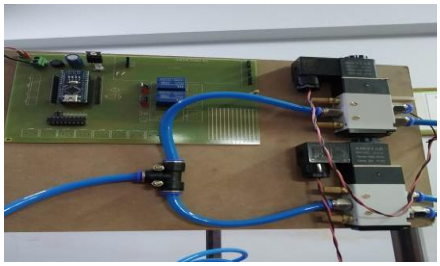

Fig. 14. Solenoid Valves

Fig. 15. Borewell setup model

The pneumatic cylinders are connected to the arms where the movement is determined by the opening and closing of the arms, according to the position of infant the arms are placed (Fig.13). The pneumatics are controlled by the solenoids (Fig.14). The arms are attached with pulley, when the arms held the infant with the help of pulley the baby is taken out and is rescued (Fig. 15).

6. Conclusion

Human life is precious. Borewell child system is a significant attempt to save life of a victim of borewell accidents. Besides this unique technique capability of climbing through vertical and inclined pipes make wide scope. This structure is strong enough to carry the child from borewell to outside. The adoption of sensors and use of pneumatics strengthens the setup. Following are some of the observations done during the fabrication of the child rescue system. The system will come up with all the circumstances that may occur inside the borewell, from tracking of the child to lifting it up to ground all the steps has been followed sequentially such that all the problems are verified and the solution is found to overcome that. The operation of uplifting the child from the bore well is the sensitive case all the precautions are taken to rescue the child without hurting it. The setup has combination of sensors and cylinders such that it can be used for a greater number of applications like in mining, pipeline designing and can also be adopted in hydrology. Hence becoming a more applicable for the real time problems, this model is effective to overcome all those problems.

References

[1] A Sumalatha, Arduino based child rescue system from bore wells, International journal of engineering research and technology, vol. 7, issue 2, February 2018, pp. 15-20.

[2] Surya saravana Pandian and Karthikeyan Sundarsamy, Multi-purpose prosthetic bore well rescue robot system, IAETSD journal for advanced research, applied sciences, vol. 5, issue 3, March 2018, pp. 13-17.

[3] Lawrence Danieal R,Vinolee R,Ruhan Bevi A, International journal of pure and applied mathematics, Design of robotic system to rescue a child under constrained environment; vol. 116, issue 5, 2017, pp. 14-20.

[4] Nish Mohith Kurukuti, Mahesh Jinkala, Purushotham Tanjeri, Somasekhar Reddy Dantla and Mallikarjuna Korrapati, "A novel design of robotic system for rescue in bore well accidents," 2016 International Conference on Robotics and Automation for Humanitarian Applications (RAHA), pp. 20-25.

[5] G. Nithin, G. Gowtham and S. Narayanan, "Design and simulation of bore-well rescuer Robot-Advanced," ARPN Journal of Engineering and Applied Sciences, vol. 9, no. 5, May 2014, pp. 25-35.

[6] B. Bharathi, B. Suchitra Samuel, "Design and Construction of Rescue Robot and Pipeline Inspection Using Zigbee," International Journal of Scientific Engineering and Research, Volume 1, Issue 1, September 2013, pp. 56-70.

[7] Friesen R. Manish Raj, P. Chakraborty and G. C. Nandi Rescue robotics in bore well Environment Cornell University library, Volume 1, January 2013, pp. 345-379.

[8] Robin R. M, Jeffery K, Samuel L. S and Rahmat S, "Novel Application of Robotics - Mobile Robots in Mine Rescue and Recovery," 2009 IEEE Robotics & Automation Magazine; pp. 91-103, pp. 78-123.

[9] Palwinderkaur, Ravinderkaur, Gurpreet Singh, Pipeline inspection and borewell rescue robot, IEEE, vol. 3, March 2011, pp. 99-134.

[10] Jeffery K, Rahmat S, "Design and application of robotics: mobile robots in mine rescue and recovery," IEEE Robotics and Automation magazine, pp. 20-89.