A novel rescuobot for borehole accidents

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Abstract: Major reports are saying that many children were dead due to the unclosed bore wells. The rescue process cannot be handled smoothly because the environment inside the bore well cannot be predicted by easy means. A less expensive robot can be developed with simple mechanisms for controlling will simplify the rescue process. A movable robot capable of adjusting to the bore well dimensions is constructed. The robot has two arms that can be adjusted to rescue the child with the support of camera also aiding in the survival of the baby. Some additional features are also introduced to enhance and ease the comfort of the rescue operation. A compressor is used to fill an air bag that is implemented in this robot to make the rescue operation easy and be comfortable to lift the victim safely. The gas and temperature inside the bore well can be measured using gas sensor and temperature sensor respectively.

1. INTRODUCTION

Robots are humanoids which are having the ability to do the impossible work easily with less consumption of time. The branch of technology that deals with the operation and designing of robots is called robotics. The solution for bore well accidents can be enhanced with this technology. The child can be picked up using arms of the robot [1]. Control systems, sensors, manipulators, power supplies and software are all working together to perform this operation. Whether rotating on wheels, moving on wheels or propelling by inner force mechanism, a robot should move. It can move their arms, head, neck, fingers as well. A robot design must be able to recharge itself. A robot might be solar powered, electrically powered, battery powered. The energy needed by the robot is directly proportional to what the robot has to do. The rescue operation robotic mechanism for bore well accidents mainly consists of three processes: approaching the child, handling the body and taking child out of the well [2].

2. THE RESCUE MECHANISM AND RELATED WORK

The children are easily prone to bore well accidents because of the smaller size. The rescue process in earlier days was too difficult: digging a hole near the surrounding area of bore well. The presence of rocks in the surrounding regions of the bore well makes the rescue operation tedious. There must not be any hindrance to the resource availability for the successful rescue operation. Absence of oxygen and light is another major difficulty faced in this rescue operation. The rescue forces from the defence sector are called upon if further help is required. Time and energy consumption is more and the rescue
expenses were too high. No special mechanism for getting the child struck inside the bore hole is available as such. A time conscious solution to this problem can be given by robotics by making direct contact to the victim.

The location of victim and further communication can be done using robots. Arm size adjustable robots are not available and the control is executed by an external person. Dynamic reconfiguration of this robotic system is not impossible although its real benefit becomes apparent when detection of obstacles and higher level avoidance is also implemented [3, 4].

3. THE NOVEL RESCUEBOT

The proposed novel rescuebot would be a perfect solution for bore hole accidents. This rescue bot not only locates the victim but also aids in further communication. Figure 1, shows the block diagram representation of the novel rescue bot. The robotic system consists of two arms made of AREXX RA1PRO which are adaptable to fit in the bore hole by adjusting its position. The adjustability of the robotic arms to the size of the bore well is a suitable feature to ease the rescue operation. The wheels are actuated by the DC motors. The driving gear mechanism and the ease of omnidirectional movement have been experimented [5].

A camera is attached to the robot, to visualize the victim and surroundings. The visual information is obtained using the camera. Augmented Reality (AR) allows computer generated virtual images to overlay on the physical objects on a real time basis [6, 9]. A compressor is used to fill an air bag that is attached in this robot to make the rescue operation easier and also be comfortable to lift the victim safely. Some sensors are fit in the rescuebot to assist and enhance the rescue operation mechanism. The gas sensor will be able to sense and identify the presence of gas type inside the bore well. The presence of any abnormal or poisonous gas can be identified easily. If needed, air filler can also be used to supply oxygen to the victim. A sound sensor detects the sound from the silent bore well and outputs digital trigger signal. A speaker is also attached to the robot. Thus we can make the child speak and hear, apart from sensing the breath of the child. A temperature sensor senses the temperature inside the bore well to aid the rescue operation. An ultrasonic sensor can be used to measure the depth of bore well and distance at which the victim is lying. Ultrasonic sensors are widely used for the rescue operation in robots [7]. W-suits have also been developed for the purpose of rescue operations [8].

Once the microcontroller receives the command from the user, it starts controlling the actuators automatically. The details are shown on Liquid Crystal Display (LCD). Initially the microcontroller is programmed with the help of PC to control the arm and motion of the robot. The motor driver circuit also controls the compressor attached to it. The different sensors start doing their respective functions immediately after receiving the commands. A power supply is required to control the whole setup which serves as life of the robot. The major hardware components used in this rescue bot are PIC16F877A, zig bee module, sound sensor, temperature sensor, gas sensor and ultrasonic sensor. Figure 2 shows the hardware module designed along with temperature detection and display.
4. THE RESULTS AND DISCUSSIONS

The Figure 3 shows the demonstration kit that was designed and experimented. Real Term software application is used in the PC for control and display. It displays the temperature, distance, sound and abnormal gas detection. All the commands are given through the PC. The control can also be done through the mobile phones. Mobile application has also been developed recently for rescue operation [10-12].

Figure 4 shows the detection of human life on the PC screen using the sound sensor that senses the respiration sound of the child. Figure 5 shows the temperature detected in the rescue process. Similarly, the presence of abnormal gas and distance were also experimented and tested successfully.
5. CONCLUSION

The smart child rescue system rescuebot is a specially designed robot saving the child from the bore well accidents. It is constructed in a way to overcome the drawbacks in the conventional methods. The omnidirectional movement and smoothness of the rescue operation have been confirmed experimentally, thus proving its effectiveness. A robot module to rescue the child within short span of time and without any major injury is designed and experimented. Robot design will require repetitive approaches to perform some task like obstacle avoidance. A thermal camera can be employed in future for taking thermal images which will detect the temperature of the victim that thus helping to identify the live status. Programmable Logic Controller (PLC) can be used for the implementation part and Supervisory Control Data Acquisition (SCADA) type of monitoring is also used. The development of robot at a low cost which will be more useful to the rural people and easy to operate is designed and implemented. A mobile interaction facility with augmented media is enabled and making a live interaction in mobile without any difficulties is experimented and tested successfully.

REFERENCES

[1]. SArthika, S Chidammbara Eswari, R Prathipa and D Devasena, Borewell Child Fall Safeguarding Robot, 2018 International Conference on Communication and Signal Processing, India, pp825-829
[2]. Nithin, G Gowtham G, Venkatachalam G and Narayanan Syama, Design and simulation of bore well rescue robot – advanced,2014, ARPN Journal of Engineering and Applied Sciences, Vol. 9 No. 5 pp 608-611
[3]. Guilin Yang, I-Ming Chen and Wee Kiat Lim, Design and kinematic analysis of modular reconfigurable parallel robots, 2016 IEEE International Conference on Robotics and
Automation

[4]. FynnSchwiegelshohn, Florian Kastner and Michael Hubner, Enabling Dynamic Reconfiguration of Numerical Methods for the Robotic Motion Control Task, 2016IEEE International Parallel and Distributed Processing Symposium Workshops pp283-288

[5]. Kenjiro Tadakuma, Riichiro Tadakuma and KyoheiIoka, Omnidirectional driving gears and their input mechanism with passive rollers, 2012 Intelligent Robots and Systems (IROS),IEEE/RSJ International Conference

[6]. Feng Zhou, Henry Been-Lirn Duh and Mark Billinghurst, Trends in Augmented Reality Tracking, Interaction and Display: A Review of Ten Years of ISMAR, 20157th IEEE/ACM International Symposium on Mixed and Augmented Reality

[7]. G Kavianand, KG Ganesh and P Karthikeyan, Smart child rescue system from borewell (SCRS), 2016 International Conference on Emerging Trends in Engineering, Technology and Science (ICETETS)pp1-6

[8]. W. K. Chung, Y. Yang, N. Cui, H. Qian and Y. Xu, Design of a rescue robot with a wearable suit augmenting high payloads rescue missions, 2017 2nd International Conference on Advanced Robotics and Mechatronics (ICARM).pp704-711

[9]. Gómez, Ana M. Bernardos and José R. Casar, A System to Enable Level-of-Detail Mobile Interaction with Augmented Media Objects, 2014 Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS), Eighth International Conference

[10]. YOhtsuka, Hishii, K Utsu and O Uchida,A smartphone application for location recording and rescue request using twitter," 2017 International Conference on Information Networking (ICOIN). pp386-388

[11]. K Utsu, A Ogata, K Sakurai, M Tsutsumi, A Suzaki, R Abe, A Manaka, H Ishii, O Uchida, Prototype Development of Twitter-Based Safety Confirmation System for Disaster Situations, 2016 22nd International Conference on Parallel and Distributed Processing Techniques and Applications (PDPTA2016), pp289-295

[12]. MaríaMartínez-Rojas, María del Carmen Pardo-Ferreira and Juan Carlos Rubio-Romero, Twitter as a tool for the management and analysis of emergency situations: A systematic literature review, 2018 International Journal of Information Management,Vol. 43, p 196