A CHILD EXTRACTION IN BOREWELL USING PICK AND PLACE ROBOTIC ARM

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Abstract-- Implementing robotic system for lifesaving measures is one of the important applications, one such implementation needs to be applied for the recovery of child from a constrained Environment more specifically bore well. Accidents associated with bore well is incredibly abundant on the rise, removal of casing pipes once a bore well changing into defunct and abandoning the borehole structure while not filling which is one in all the most reasons for children slithering into them. To assist in such rescue operations we tend to propose a robotic system capable of moving underneath the bore well supported with user commands equipped with a robotic arm, high power LED, high-resolution camera, and sensors like ultrasonic, temperature and gas sensor. Single cameras were placed at different angles so that the entire bore well was captured which are controlled through raspberry pi SOC. Robotic arm is designed uniquely where it operates with 4-point gripping system in which each pair is controlled separately in order to increase the precision of the grip, additionally a fail-safe safety system was designed which provides additional safety in rescue operation. Robotic arm is operated by the rescue team through a specially designed control system software. This project is done by using raspberry pi single board computer with various sensors like temperature, smoke, and pressure sensor. The temperature sensor is used to the temperature inside the bore well. Pressure sensor is used to calculate the pressure level. Smoke sensor used to detect the poisonous gas in bore well. Pick place robot is used to extract the child using real-time video camera streaming.

I INTRODUCTION

Today's major problem faced by human society is water scarcity, which leads to a large number of bore wells being sunk. Bore wells yield may reduce due to over usage and continuous pumping for agricultural and domestic operations. Increasing bore wells in that particular area causes more groundwater stress which results in the bore will be dried up. In most of the cases, such bore wells are relinquished that cause more danger to human well-being and further more causes serious ground water contamination. These bore wells in turn have started to take many innocent lives. Bores which yielded water and subsequently got depleted are left uncovered. Small children without noticing the hole dug for the bore well slip in and get trapped. There is no proper technique to rescue victims of such accidents. In most cases reported so far, parallel hole is dug up and then a horizontal path is made to reach to the subject's body. It is not only a time taking process, but also risky in various ways. Moreover it involves a lot of energy and expensive resources which are not easily available everywhere and this process always need big space around the trapped bore well. These ad-hoc approaches involve heavy risks including the possibility of injuries to the body of subject during the rescue operations. Also, the body may trap further in the debris and the crisis deepens even more means death.

In most cases, there is a need to rely on some makeshift arrangements. This does not assure thatany long term solution. In such methods some kind of hooks are employed to hold the sufferers clothes and body. This may cause wounds on the body of the subject. Now-a-days everything can be controlled by human being which is being automated using machines and electronics circuits. An embedded system is a computer system designed to perform one or a few dedicated functions often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. By contrast, a general-purpose computer, such as a personal computer (PC), is designed to be flexible and to meet a wide range of end-user needs. Embedded systems control many devices in common use today. Microcontrollers are commonly referred to as general purpose processors as they simply accept the inputs, process it and give the output. In contrast, a microcontroller not only accepts the data as inputs but also manipulates it, interfaces the data with various devices, controls the data and thus finally gives the required result.

II LITERATURE SURVEY

Implementing robotic system for life saving measures is one of the important applications, one such implementation needs to be applied for recovery of child from constrained environment more specifically bore well. Accidents associated with bore well is incredibly abundant on the rise, removal of casing pipes once a bore well changing into defunct and abandoning the borehole structure while not filling which is one in all the most reasons for children slithering into them. In the recent history of country, only one child Sandhiya of Bellary on April 11, 2002 and Prince from Haryana, was rescued alive from the bore well. Six year old boy Deivaraj on June 8, 2004 was rescued from the bore well, but later died in the hospital due to injuries during the rescue operation and lack of medical aid.

In the past few years, there have been several accidents of children falling into abandoned bore wells in India. Abandoned bore wells that have turned into death pits for children. The problem is all over India. Rescue teams spend hours and sometimes days in futile attempts to save these little kids. A lot of money is also spent in these missions. In most cases they are unable to save the kids. Such events have happened several times in the past, and every time either the government or the bureaucracy is blamed. The rescue process to save the child from bore well is a long and complicated process now. The rescue team tries to approach the victim from a parallel well that take about 20-60 hours to dig. This complicated process makes 70% of the rescue operations fail.

Now-a-days child often fall down in the borehole which is left uncovered and get trapped. It is very difficult and also risky to rescue the trapped children. A small delay in the rescue can cost the child his or her life. The objective of the project is to construct and design a bore well rescue robot (i.e., to rescue a trapped baby from bore well). This project is a human controlled robot that gives an insight view of rescuing the baby safely and steps taken to achieve this. The project aims in designing “Robot to rescue of a child in a borehole” which is capable of moving inside the pipe according to the user commands given from Personal Computer.

The rescue process to save the child from bore well is long and complicated. To avoid this, there have been several rescue robot designs available currently. Even now the existing robots are not satisfactorily used to rescue the child from bore hole. For this reason, a morphological chart is designed from existing and new robot designs. From the morphological chart, various combinations of rescue robot design are formulated. Finally, the designs are compared for the best performance. An additional component like digital oxygen supply system, digital integrated camera, strain measuring pressure sensors, rope and pulley drive are added to the design to improve rescue operation. A lot of other hassles are avoided by this alternative technique.

III PROBLEM FORMULATION

An innovative method is proposed for rescuing a child from a borehole and to keep the child in conscious state. Children accidentally fall into the borehole which yielded water and subsequently left uncovered. A suitably strong

cap of bright color to cover the mouth of the borehole will avoid such accidents. It is difficult and also risky process to rescue the trapped child after fallen into the borehole. In this paper, a robot is designed in such a way that it handles the trapped child carefully and monitors the child continuously. The robot structure consists of power supply, gear motors, oxygen concentrator, camera and micro controller, robotic arms, temperature sensor, audio player which has parents voice, heart beat monitoring system, lifting rods, servo motors. The condition of the child is captured with CCTV camera and monitored on a TV. The proposed system is implemented using NI LabVIEW software. This robot type machine can rescue trapped body from the borehole in a highly secure way.

The aim of the project is to rescue of trapped child in to the boar well by continues monitoring and supply of necessary items to survive using technical method. These bore wells in turn have started to take many innocent lives. Bores which yielded water and subsequently got depleted are left uncovered. Small children without noticing the hole dug for the bore well slip in and get trapped. To aid in such rescue we have proposed a system. This method is to keep a child alive in a bore should take in to consideration the lack of oxygen, increased temperatures and humidity, which produces hyperthermia. These problems are addressed with fresh air delivery with or without oxygen. A hand-powered equipment to deliver fresh air inside bore is being designed. This method brings down temperature and delivers fresh air. Visualizing the child is made possible with infrared waterproof cameras and a portable high resolution TV Monitor. This is light weight machine that will go down into the bore well pipe and save the child life systematically. This machine will go down the bore well and perform the action. This robot type machine can stay alive trapped body from bore well until parallel hall will be dug up which will work as minimum amount of time and save the child life systematically.

IV OBJECTIVE

The main objective of this paper is to implement robotic arm for rescuing the child in bore well. It is fast, economical and safe. It has the facility to monitor trapped child and to provide a supporting platform to lift up the child. This systems will attach a harness to child using robotic arms for picking up. It includes an ultrasonic sensor to calculate the distance to the child. A temperature sensor is used to measure the temperature inside the bore well. The robotic arm has motor attached to it for picking and placing. This systematic design will easily rescue the child within short time without major injury. Visualizing the child is made possible with infrared waterproof cameras and a high resolution TV monitor. This is a light weight machine that will go down into the bore well pipe and save the child's life systematically by performing the required action. The main objective of this design is to reduce the time for reaching the child and to ensure the safe handling of victim.

V BLOCK DIAGRAM AND EXPLANATION

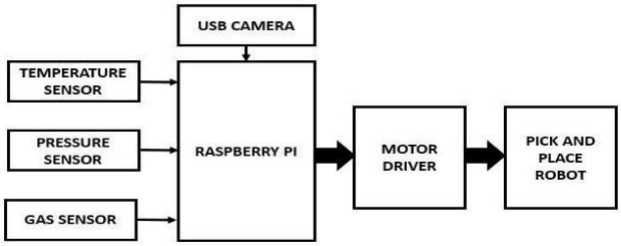

Figure 1. Block diagram of child rescue robotic arm

A power supply of 230V is given to Raspberry Pi board and it is converted to 12V using step down transformer to run the servomotor. This motor driver is used to control the robotic arm. Here the temperature is used to measure the temperature of child to check whether the temperature of the body is normal or not. The threshold value of temperature sensor for child rescue system is 50 deg Celsius. Heart beat sensor is used to

measure heart rate in real time and gas sensor is a device that detects the presence of poisonous gas (proportion of hydrocarbons, methane, volatile organic compounds in parts per million(ppm)) in an area as part of safety system. Ultrasonic sensor is used to measure the distance at which the victim is presented. These measured values of temperature, pressure and gas sensor are analog in nature therefore analog to digital converter is used to convert the sensed analog values into digital values. These values are displayed in Raspbian OS. During the rescue operation the robot setup is sent to the bore well till the victim is found, later the parameters are sensed by the sensors. The transmitter in bore well is used to send the signal of temperature, pressure, and presence of poisonous gaseous. The robot then grasps the target by contracting or expanding its gripper according to the requirement. The robot holds the child tightly and take them out safely. Also the video captured by the USB camera is monitored on the laptop which gives the insight view of the borehole to perceive the location and position of the child and also able to detect any fault inside the pipeline.

VI HARDWARE AND SOFTWARE DESCRIPTION

[A] RASPBERRY PI

The Raspberry Pi board contains a processor and graphics chip, program memory (RAM) and various interfaces and connectors for external devices. Some of these devices are essential, others are optional. Raspberry Pi operates as a standard PC, requiring a keyboard for command entry, a display unit and a power supply.

[B] PICK AND PLACE ROBOT

The basic function of pick and place robot is done by its joints. Joints are analogous to human joints and are used to join the two consecutive rigid bodies in the robot. They can be rotary joint or linear joint. To add a joint to any link of a robot, it is necessary to know about the degrees of freedom and degrees of movement for that body part. Degrees of freedom implement the linear and rotational movement of the body and Degrees of movement imply the number of axis the body can move. A simple pick and place robot consists of two rigid bodies on a moving base, connected together with rotary joint.

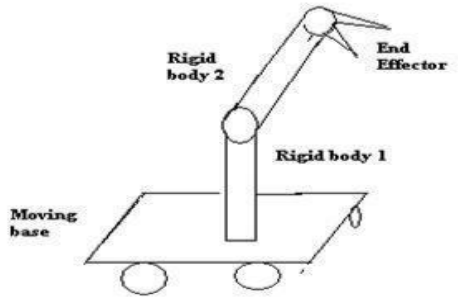

Figure 2. Pick and Place Robot

[C] POWER SUPPLY

All electronic circuits works only in low DC voltage, it is necessary to provide the appropriate voltage supply for their proper functioning. AC voltage of typically 230volts rms is connected to a transformer. A regulator circuit can use this dc input to provide dc voltage that not only has much less ripple voltage but also remains the same dc value even the dc voltage varies or the load connected to the output dc voltages changes. The block diagram is shown in Figure 3.

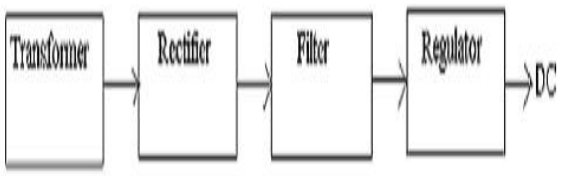

Figure 3. Block Diagram of Power supply

[D] SERVOMOTOR

A servo mechanism, or servo, is an automatic device that uses error-sensing negative feedback to correct the performance of a mechanism. The term correctly applies only to systems where the feedback or error-correction signals help control mechanical position or other parameters. It allows precise control of angular or linear position, velocity and acceleration.

[E] ULTRASONIC SENSOR

The ultrasonic sensor measures the distance at which the victim is present and displays depth in both cm and m. The modules includes the ultrasonic transmitters, receiver and control circuit. Here the rescue unit is nothing but the robotic arm which contains ultrasonic sensor, LED display and a web camera.

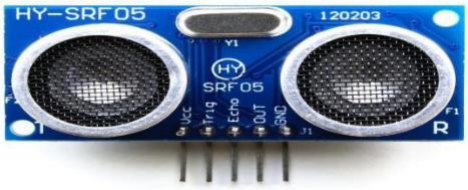

Figure 4 Ultrasonic Sensor

[F] SPECIFICATIONS OF ULTRASONIC SENSOR

Table 1. Specification of Ultrasonic Sensor

Supply voltage	5v
Global current consumption	15 mA
Frequency	40 KHz
Maximal distance range	400 cm
Minimal distance range	3 cm
Resolution	1 cm
Trigger Pulse Width	10 us
Dimension	43*20*15 mm

[G] TEMPERATURE SENSOR

The LM35 Temperature sensor is commonly used temperature sensor that can be used to measure temperature with an electric output comparative to the temperature (in degree Celsius). It measures the temperature very correctly when compared to the thermistor.

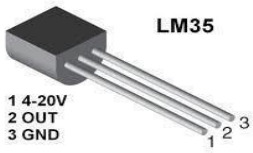

Figure 5. Temperature sensor

[H] GAS SENSOR

A gas sensor is a device that detects the presence of gases in an area, often as part of a safety system. This type of equipment is used to detect a gas leak or other emissions such as carbon monoxide, chlorine and can interface with a control system, so the process can be automatically shutdown.

Figure 6. Gas sensor

[I] CAMERA UNIT

The whole scenario will be live streamed through the communication module which will publish the images from the cameras of the robot. The family members of the victim can also see the condition where their family member is been stuck. Some of them can also collaboratively help the rescue process by soothing the victim with their affectionate talks. The person operating the robotic arms can also the view the images from the live cameras at the top, as well as the cameras situated at the tip of the arms. The arm-tip cameras will provide the view of the route of the arms for attaching the straps of the harness, also bringing the food-bag or oxygen mask to the victim.

Figure 7. Camera Unit

SOFTWARE UNIT

The software technique used is Raspbian and it is the main and basic software for RPi devices, officially supported by the Raspberry Pi Foundation. In fact, it is an operating system, based on Debian and optimized for Raspberry Pi hardware. It comes with lots of pre-installed pieces of software appropriate for most of ARM users and developers. This operating system is a lightweight version of Linux that is optimized for this low powered device. The Raspberry Pi is an inexpensive and miniature computer. Raspbian provides more than a pure OS, it comes with over 35,000 packages, pre-compiled software bundled in a nice format for easy installation.

VII RESULT

A power supply of 230V is given as input to Raspberry Pi board and it is converted to 12V using step down transformer to run the servomotor. This motor driver is used to control the robotic arm to pick the object as shown in Figure 6.1.The robot then grasps the target by contracting or expanding its gripper according to the requirement. This robotic arm holds the object tightly and take them out safely.

Figure 8. Rescue Operation

The temperature sensor measures whether the body temperature is normal or not. Heart beat sensor measures heart rate in real time and smoke sensor measures the presence of poisonous gas (proportion of hydrocarbons, methane, volatile organic compounds in parts per million(ppm). Ultrasonic sensor measures the distance at which the victim is presented. These measured values of temperature, pressure and gas sensor are displayed in Raspbian OS which helps in monitoring the health condition of the victim as shown in Figure 8.

VIII CONCLUSION

Finally it is concluded that this current design of bore well child saver machine is has been made to suit every possible situation may occur in rescuing operation. The structure is made strong enough to sustain all possible loads, though it is made flexible at the same time to adjust wide range of bore diameter and any change in the diameter of bore. In this rescuing operation time is a vital factor which alone can determine the success or failure of the whole operation. It performs rescue operations in very less time as compared to traditional methods. Thus it has been designed keeping the entire obstacle in mind that may arise during the operation. The controlling of the vehicle and the rescue robot is highly sensitive that makes it possible to reach to high depth as soon as possible and handle the human child without hurting.

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