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A Multifunctional System Based Rescue Robot Adapted For Borehole Accidents Controlled Using Arduino

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Abstract- Many child deaths are reported in the past due to bore well accidents. During bore well accident an immediate rescue operation is required and it is quite challenging to perform a rescue operation as the environment inside the bore well is highly unpredictable. Developing low cost robotic system and simple control will help rural people use it easily. In this paper, we propose a novel design of rescue robot which would enlarge as per the diameter of bore well and attach to the bore-well by adjusting to the diameter while travelling up or down the bore-well. It would contain two artificial arms, which would help in holding the baby with the visual help offered by camera and also aid in the survival of the child.

I. INTRODUCTION

Water scarcity is the major problem faced by the human society. Due to drought and depletion of underground water more borewells are drilled on the surface of the earth. Due to water scarcity more borewells are being sunk. In many areas the borewells are drilled and left as it is open without any proper covering. These abandoned borewells have become death pits and started taking many innocent lives especially small children. Now a day falling of children in borewells are increasing due to the carelessness and playful activities of the children. The holes dug for the borewells are deep around 700 feet. In these cases the rescue of children from such deepest borewells is quite challenging. Many times the rescue system for children from borewells may risk the child's life. System for rescuing the child from borewells is not only difficult and also very risky to save the trapped child's life. A small delay in rescue operation can even cost child's life. Even though the necessary rescue operation taken, many factors such as lack of oxygen, increasing temperature and humidity in such depth will be another risk for child's life so for there is no proper solution available for giving relief to such accidents. In order to overcome these hurdles a new system of preventing child from falling in to borewells is designed and named as child rescue system. Wireless relays on mobile robots, such as wheeled or flying robots, can meet the above requirements because of their mobility. In this case, optimizing the communication quality of an entire network is necessary. However, a wireless network can be seriously affected by complex environmental conditions. Thus, identifying relay control strategies to optimize communication capability can be quite challenging. The number of mobile devices and wireless networks significantly increased in the past decade; thus, wireless ad-hoc networks became one of the most active aspects in communication technologies. Nguyen et al. utilized mobile robots as relays to build a wireless network; however, they did not consider the influence of complex environments in their approach. Tan et al. proposed a routing protocol that allows a user to determine the transmission priority of data streams over a wireless mobile ad-hoc network. Santi et al. developed an approach to maximize communication range when the network is connected with a high degree of probability. In a similar manner, people attempted to address the problem by optimizing various connectivity criteria based on graph theory. Cheng et al. considered a special relay communication scenario for delay-tolerant applications, wherein the unmanned aerial vehicle (UAV) relays are used to carry data and deliver them when these relays approach user terminals. The routing issues of hierarchical networks have also been studied. Several algorithms have been designed to reduce routing overhead and improve throughput, and UAV nodes have been utilized to relay messages at high levels.

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II. LITERATURE REVIEW

In 2013, Bharathi B . , Suchitha Samuel B., published a paper about “Desgin and construction of recue robot and pipeline inspection using zigbee. describes the designing a robot for rescue a child from inside bore well, which is capable of moving inside the bore well, according to the human comment by PC and also pick and placing based on arm design. . The robot is operated through PC using wireless Zigbee technology and using wireless camera can view both audio and video on the TV. This robot has a high power LED which acts as a light source when light intensity inside the pipe is low. It is a low cost robot used to monitor and the human controlled robot that gives an insight view of rescuing the baby safely taken to achieve this.

In 2014, Palwinder kaur, Gurpreet singh, published a paper about“pipeline inspection and borewell rescue robot” describes the rescue operations without human intervention. Here the wheeled leg mechanism is design to go inside the pipe and the legs are circumferentially and symmetrically spaced out 1200 apart. The robot can adjust its legs according to the pipeline dimensions. The robot has consisting of power supply, switch pad, and gear motor. The child position is captured from bore well with USB Camera and monitored on PC. The LM35 temperature sensor and 16*2 LCD are interfaced with PIC 16F877A microcontroller to sense and displays on LCD.

In 2009, John Jose Pottery, published a paper about “robot for borewell rescue”. describes the facility to monitor the trapped child, supply oxygen and provide a supporting platform to lift up the child. The 1st motor placed at 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. The 2nd motor placed below the plate turns the bottom shaft by 360 degrees, the helping to locate the gap through which the lifting rod passes. This is done with the help of a wireless camera attached to the lifting rod.

In 2014, manish raj , published a paper about “rescue robot for borewell environments”. describes as the diameter of the borewell is narrow for any adult person and light goes dark inside it, the rescue task those situations is challenging. The robotic system which will attach a harness to the child using pneumatic arms for picking up. A teleconferencing system will also attach to the robot for communicating with the child.

In 2017, Saran k, Vignesh S., Marlon Jones Louis, published paper about”design and Frabrication of pneumatic borewell child”. 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.

III. PROPOSED SYSTEM

This proposed system would be a very dependable solution for such accidents. A robotic system can be used to locate the victim and also help to establish communication with the victim. In this paper, we would like to discuss the development of a robotic system. This system requires Ultrasonic sensor is used to get data of the distance between the robot wheel and the wall of the Bore well. Camera module: The main function of camera module is to provide visual information to the operator. Servo Motor: Servo motor is used to control the artificial arms of the robot. DC motors are used to actuate the wheels of the robot. The whole robotic mechanism must control by user through wired communication. Once the Microcontroller receives the command form the user it starts controlling the actuators automatically. In this project we have proposed a new method to rescue the child from bore wells using a prosthetic hand. In this we will be retaining few sensors so that we can monitor the child. With the help of a prosthetic hand we will catch hold of the child and lift the child gradually. Here we will adjust the position of the prosthetic hand with help of two motors.

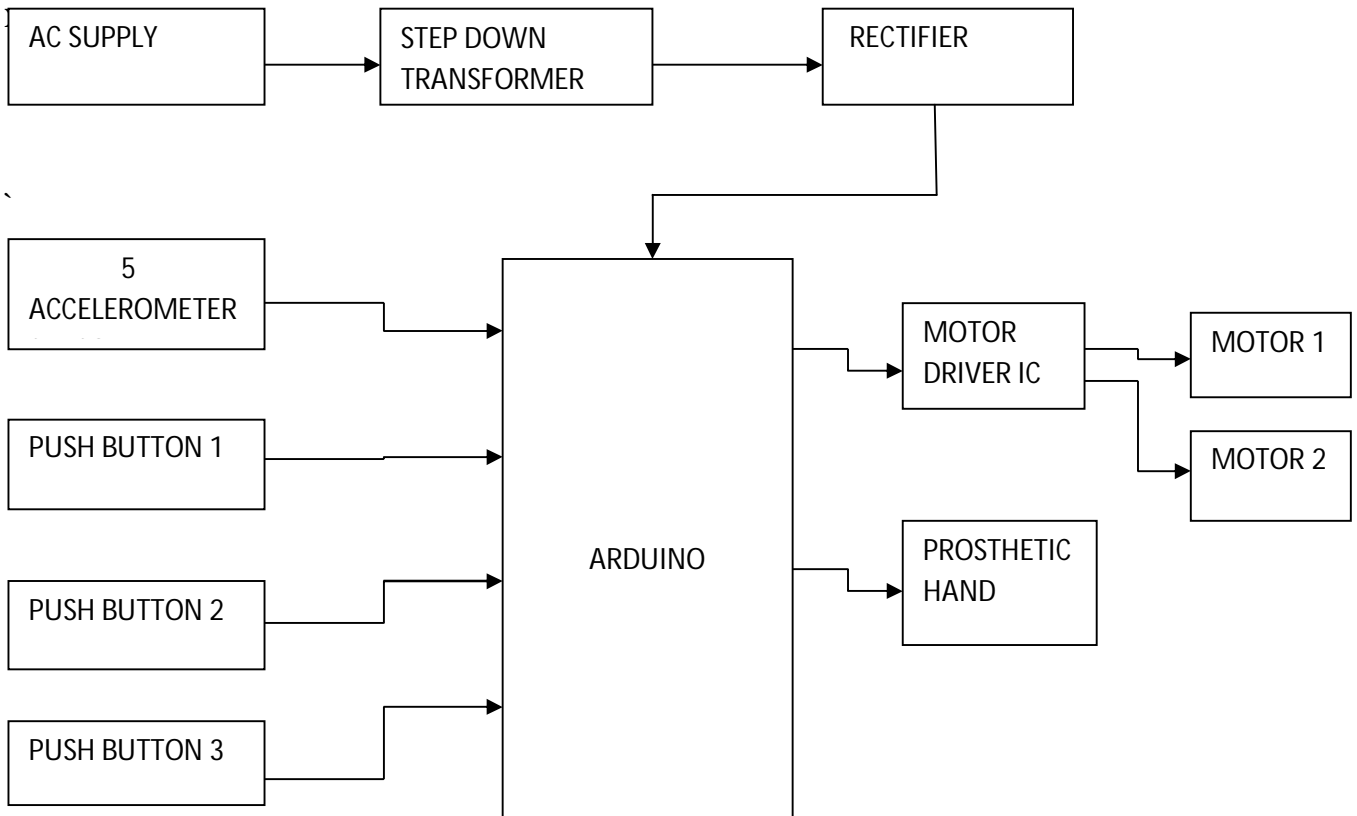
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Block Diagram of Proposed System



ACCLEROMETER

The ADXL345 is a small, thin, low power, 3-axis MEMS accelerometer with high resolution (13-bit) measurement at up to +16 g. Digital output data is formatted as 16-bit two's complement and is accessible through either a SPI (3- or 4-wire) or I2C digital interface. The ADXL345 is well suited to measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion or shock. Its high resolution (4 mg/LSB) enables measurement of inclination changes less than 1.0 degrees; Several special sensing functions are provided. Activity and inactivity sensing detect the presence or lack of motion and if the acceleration on any axis exceeds a user-set level. Tap sensing detects single and double taps. Free fall sensing detects if the device is falling. These functions can be mapped to one of two interrupt output pins. An integrated, patent pending 32-level first in, first out (FIFO) buffer can be used to store data to minimize host processor intervention. Low power modes enable intelligent motion-based power management with threshold sensing and active acceleration measurement at extremely low power dissipation.

Based on the ADXL-345, this digital 3-axis accelerometer has excellent EMI protection. Its variable output makes it suitable for a wide range of applications:

- HDD shock protection
- Vibration sensor
- Game controller input
- Robotics

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ARDUINO:

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project is based on microcontroller board designs, manufactured by several vendors, using various microcontrollers. These systems provide sets of digital and analog I/O pins that can be interfaced to various expansion boards ("shields") and other circuits. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on the Processing project, which includes support for the C and C++ programming languages.

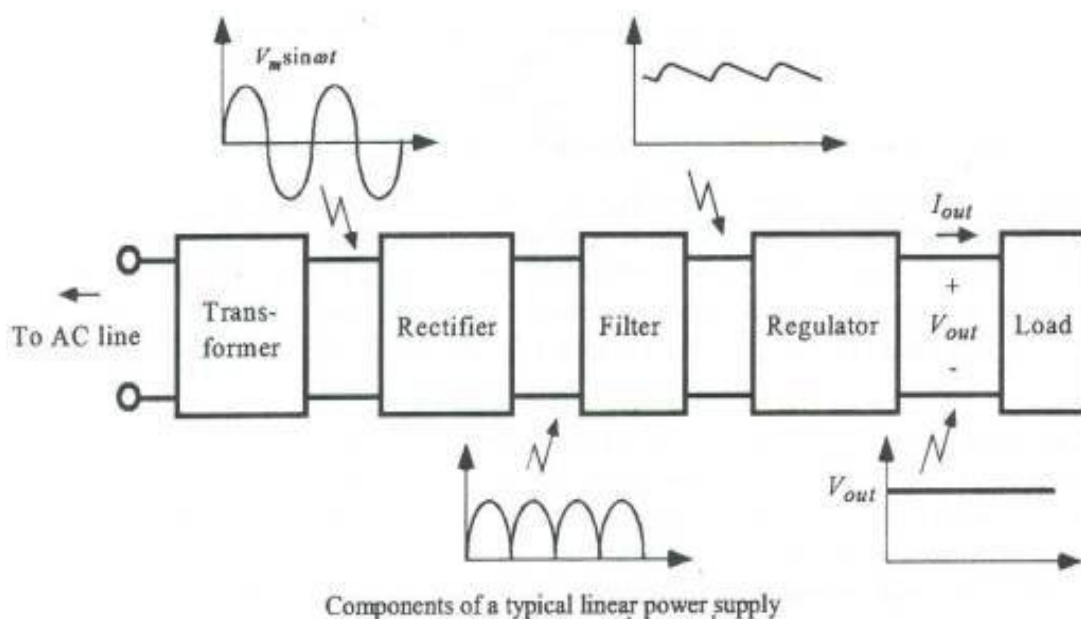
Arduino Microcontroller

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software [2]. The Arduino microcontroller is essential to the design of the SRC as it provides communication between the voice recognition components and the graphical user interface (GUI). The 8 bit data bus provides communication between the microprocessor and the HM2007.

After Arduino microprocessor reads the 8 bit data bus, the programmed microcontroller will decode and manipulated the 8 bit signals. After processing the 8 bit signals, the Arduino microcontroller sends the ASCII equivalent of the spoken word or phrase through a USB connection to the GUI. The GUI is written in the Processing language, which is based on Java. The details of the software used to program the Arduino microcontroller and the GUI will be discussed in later sections.

POWER SUPPLY

LPC 2148 works on 3.3V Power Supply, So LM117 a 1A low dropout regulator designed to provide 3.3V from a 5V supply. It is ideally suit for systems which contain both 5V and 3.3V logic, with prime power provided from 5V bus. Because the LM3940 is a true low dropout regulator, it can hold its 3.3V output in regulation with input voltages as low as 4.5V. The component of typical linear power supply.



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Transformer:

A transformer can be defined as a static device which helps in the transformation of electric power in one circuit to electric power of the same frequency in another circuit. The voltage can be raised or lowered in a circuit, but with a proportional increase or decrease in the current ratings



In this system it is used to step down 230V AC to 9V AC supply and provides isolation between power grids and circuit.

Rectifier:

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification. For most power applications, half-wave rectification is insufficient for the task. The harmonic content of the rectifier's output waveform is very large and consequently difficult to filter.

Furthermore, the AC power source only supplies power to the load one half every full cycle, meaning that half of its capacity is unused. Half-wave rectification is, however, a very simple way to reduce power to a resistive load. Some two-position lamp dimmer switches apply full AC power to the lamp filament for "full" brightness and then half-wave rectify it for a lesser light output.

If we need to rectify AC power to obtain the full use of both half-cycles of the sine wave, a different rectifier circuit configuration must be used. Such a circuit is called a full-wave rectifier. One kind of full-wave rectifier, called the center-tap design, uses a transformer with a center-tapped secondary winding and two diodes.

IV. MOTOR

DC MOTOR

- A DC motor is any motor within a class of electrical machines whereby direct current electrical power is converted into mechanical power. Most often, this type of motor relies on forces that magnetic fields produce. Regardless of the type, DC motors have some kind of internal mechanism, which is electronic or electromechanical. In both cases, the direction of current flow in part of the motor is changed periodically.

- The speed of a DC motor is controlled using a variable supply voltage or by changing the strength of the current within its field wind rings. While smaller DC motors are commonly used in the making of appliances, tools, toys, and automobile mechanisms, such as electric car seats, larger DC motors are used in hoists, elevators, and electric vehicles.

A [12v DC motor](#) is small and inexpensive, yet powerful enough to be used for many applications. Because choosing the right DC motor for a specific application can be challenging, it is important to work with the right company. A prime example is MET Motors, which has been creating high-quality permanent magnet DC motors for more than 45 years.

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SERVO MOTOR

A **servo motor** is an electrical device which can push or rotate an object with great precision. If you want to rotate and object at some specific angles or distance, then you use servo motor. It is just made up of simple motor which run through **servo mechanism**. If motor is used is DC powered then it is called DC servo motor, and if it is AC powered motor then it is called AC servo motor. We can get a very high torque servo motor in a small and light weight packages. Doe to these features they are being used in many applications like toy car, RC helicopters and planes, Robotics, Machine etc.

WORKING SYSTEM FOR SERVO MOTOR

A servo consists of a Motor (DC or AC), a potentiometer, gear assembly and a controlling circuit. First of all we use gear assembly to reduce RPM and to increase torque of motor. Say at initial position of servo motor shaft, the position of the potentiometer knob is such that there is no electrical signal generated at the output port of the potentiometer. Now an electrical signal is given to another input terminal of the error detector amplifier. Now difference between these two signals, one comes from potentiometer and another comes from other source, will be processed in feedback mechanism and output will be provided in term of error signal. This error signal acts as the input for motor and motor starts rotating. Now motor shaft is connected with potentiometer and as motor rotates so the potentiometer and it will generate a signal. So as the potentiometer's angular position changes, its output feedback signal changes. After sometime the position of potentiometer reaches at a position that the output of potentiometer is same as external signal provided. At this condition, there will be no output signal from the amplifier to the motor input as there is no difference between external applied signal and the signal generated at potentiometer, and in this situation motor stops rotating.

ZIG BEE

Zig Bee is a wireless networking standard that is aimed at remote control and sensor applications which is suitable for operation in harsh radio environments and in isolated locations. Zig Bee technology builds on IEEE standard 802.15.4 which defines the physical and MAC layers. Above this, Zig Bee defines the application and security layer specifications enabling interoperability between products from different manufacturers. In this way Zig Bee is a superset of the 802.15.4 specification. With the applications for remote wireless sensing and control growing rapidly it is estimated that the market size could reach hundreds of millions of dollars as early as 2007. This makes Zig Bee technology a very attractive proposition for many applications.

V. CONCLUSION

In last 10 years, a lot of lives have been lost due to falling in borewell because it involves digging a pit beside a borewell which is very time consuming. The proposed system is to over come all these difficulties. This project is used to reduce human effects for rescuing operations from borewell. It performs rescue operations in very less time as compare to humans.

VI. RESULT

The robot designed is able to give the conceptual scenario in the situation of rescuing child from borehole which can be made in use by the government. By using this concept, robots for this situation can be made on the large scale for saving the life of child.

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