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Design and Development of Robotic System to Assist a Child under Constrained Environment

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***Abstract*— Due to bore well accidents many child deaths have occurred earlier. An immediate recovery operation is required during the** bore well **accidents and it is quiet challenging to perform a recovery operation as the environment inside the bore well is highly unpredictable. Developing low cost robotic system and simple control will help rural people to make use of it. Arduino Bluetooth control App inventor has develope**d using an android application **and a** Bluetooth **communication is made with robot wh**ich interfaces with ATmega328p M**icrocontroller to control its speed and direction. The work is aimed towards the designing and contro**l**ling the motion of robot using** Bluetooth **device of an Android phone.**

Keywords*— Borewell, Microcontroller, Bluetooth, Robotic System*

I. INTRODUCTION

The 21st century has been an epoch of innovation and development. With the help of technological advancement almost every field has been revolutionized .These advancements have made our life more luxurious and comfortable. Though the epoch has seen a lot of development on the other hand it has also seen a rise in global warming. The water scarcity has been one of significant issues in many countries. India being an agrarian country where the farmers depend mainly on the ground water for the agriculture, deeper bore wells are dug for groundwater abstraction. Bore wells yield may reduce due to the over usage and continuous pumping for agricultural operations. Increasing of 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 abandoned that stance more noteworthy danger to human or creature wellbeing and further more cause serious groundwater contamination.

Nowadays children regularly fall down in the uncovered bore wells and get trapped. These mischances are basically occurred because of carelessness or fun loving exercises of the child. Moreover, a large portion of the drag wells are bored and left as it as open with no appropriate covers. At the point when a child falls into the drag well, the current recovery operations in such a cases are less secure. The recovery operation for the most part comprises of three procedures: Approaching the injured, handling the body and taking the child out of the well.

In the past many solutions have been proposed which have a rope, suspended, and a grasping mechanism at one of its end. In the field during operation, it is difficult to mount any modules onto a rope using any mechanism. Also when certain amount of mass is attached to the end of the rope, even small disturbances at one end result in amplified disturbances at the free end. Thus it was considered as an unreliable solution for rescue operations. Thus, a robotic system would be a very dependable solution for such accidents. A robotic system can be used to locate the injured child and also help to establish connection with the victim by communication. In this paper, a robotic system will be developed which helps in the recovery operation in bore-well environment. The operation would consist of rescue a child.

II. LITERATURE SURVEY

1. Mohith Kurukuti, Mahesh Jinkala, Purushotham Tanjeri, Somasekhar Reddy Dantla and Mallikarjuna Korrapati, **"**A Novel Design of Robotic System for Rescue in Bore well Accidents" International Conference on Robotics and Automation for Humanitarian Applications (RAHA), 2016. This paper outlines 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 consists of two artificial arms, which would help in holding the baby with the visual help offered by camera and also help in the survival of the child. A model is made with help of 3D printing technology and tested with basic weights.

2. Kavianand. G, Gouri Ganesh K, Kartikeyan, **"**Smart Child Rescue System from Borewell" IEEE, 2016. In this Paper they have designed a new system in which at the top of a borewell a sensor has been kept that helps to sense the child if he/she fell inside. The automatic horizontal closure which is kept at around five feet depth closes whenever the system senses the child and prevents the child from falling underneath it. It is easy to recover the child from five feet than five hundred feet. It also warns by giving siren and messages to rescue team and concerned officials with that location. Hence this system will help to prevent the child from falling in borewell and get stucked.

3. Yong yang, Guiyun Xu**,** "Parent Child Robot System for Rescue Missions"**,** International Journal of Pure and Applied Mathematics, 2016. In this paper they have described a robotic system which consists of parent robot, a tracked child robot and a legged robot. The parent robot has high flexible and can climb over ordinary obstacles. The tracked child robot is relatively small and high flexible surveyor type. The legged child robot is also small and assessor type as well, which has superior adaptability in narrow spaces. Drawback of this paper is, if there is any failure in parent robot then it will affects child robots and also it costs much.

III. SYSTEM DESIGN

The Fig. 3.1 shows the block diagram of robotic system which consist of Arduino Nano, DC motors, Bluetooth HC – 05, Motor driver L298D, Ultrasonic sensor, Gripper.

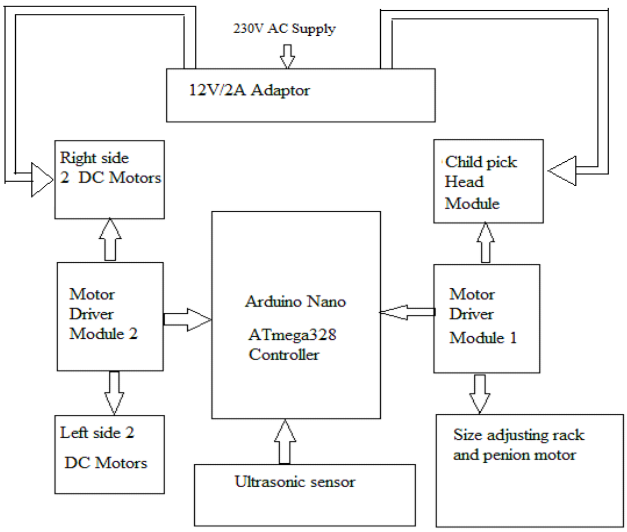

Fig. 1. Block diagram of Robotic System to assist a child under constrained environment

Ultrasonic Sensor

Ultrasonic Sensors sends a high frequency signal and calculates the distance of the object by the received signal. Ultrasonic sensor is used to get the information regarding the distance between the robot wheel and the wall of the bore well.

DC Motors

DC motors are used to trigger the wheels of the robot. It is also used to control the rack and pinion gears.

Arduino Nano

Arduino Nano is used for controlling the actuators. It uses the chip ATmega328p. It has 16 MHz (Mega Hertz) quartz crystal with 14 input/output digital pins and 6 analog input pins. It also has power-jack, ISP header and reset button. It is re-programmable with USB connector.

Bluetooth Module(HC-05)

Bluetooth is used as a communication protocol for controlling the micro-controller board, which is used for servo motors. Operator transmits the signal to servo motors using bluetooth module. HC-05 module which was designed for wireless connection setup was used.

Motor Driver module L298D

Motor driver is used to amplify a signal. It is used to take a low current signal as an input and send a high current signal as output. The IC used in the motor driver is L293D.The Voltage rating for the motor driver used is 12V. It works on the H-bridge. It gets the low current signal from the micro-controller and amplifies it and sends the amplified signal to the DC motor.

12V DC Adapter

The power supply used for the robotic system is mounted on the system. It is a Li-ion battery with a capacity of 2650 mAh (Milliamp Hour). It has an output voltage of 11.1V (Volt) and has 3 cells in it. It gives a constant discharge of 20C.

IV. SYSTEM IMPLEMENTATION

The circuit is built by using ATmega 328 controller board, ultrasonic sensor, HC-05 Blue-tooth module, motor driver L293D , five DC motors M1p, M1n, M2p, M2n and a few common components. The circuit uses 12V adapter as power supply. Adaptor mainly supplies power to controller and two motor driver modules. Adaptor coverts 230V AC (Alternating current) supply to 12V DC (Direct Current) signal. For the rest of the circuit the regulated 5V power supply is provided by the ATMEGA 328 controller board. LED (Light Emitting Diode) on the board indicates existence of power supply. Motor Driver H-Bridge is used to drive two motors which work on 9V DC power. DC motors are interfaced to the Microcontroller. The data which is received by the Blue-tooth module from Android smart phone is fed as input to the controller.

L298D motor driver 1 drives two dc motors of side wheels and a dc motor of gripper, motor driver 2 drives two dc motors of rack and pinion which are responsible for direction control and opening and closing of gripper. Trigger pin of ultrasonic sensor1 connected to pin number 5 and its echo pin is connected to pin number 6 of the controller. Ultrasonic sensor2 trigger pin connected to pin number 7 and its echo pin is connected to pin number 8 of the controller. After powering the system open the Arduino IDE software then select port, board type.

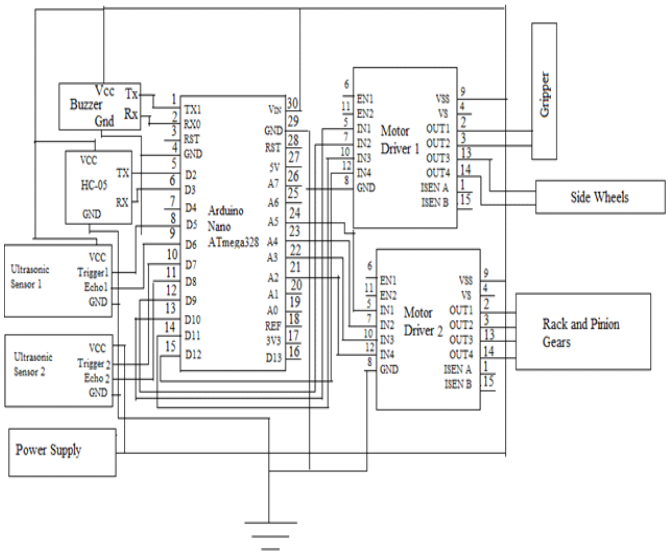

Fig. 2. Circuit diagram of Robotic System to assist a child under constrained environment

V. RESULTS

The snapshots of different steps involved in designing & development of the robotic system to assist a child under constrained environment are shown below:

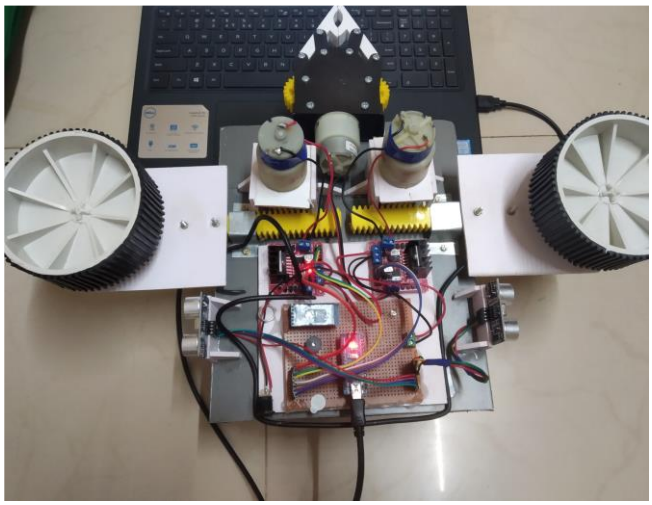

Fig. 3.1 Snap shot of designing the robotic system to rescue a child

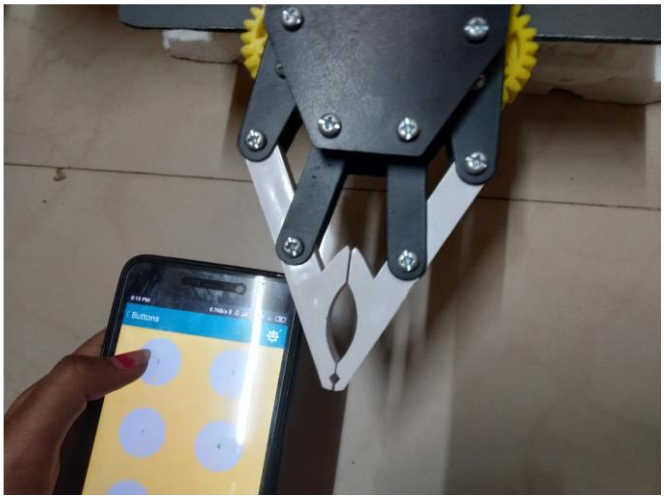

Fig. 3.2 Snap shot of closing the arm

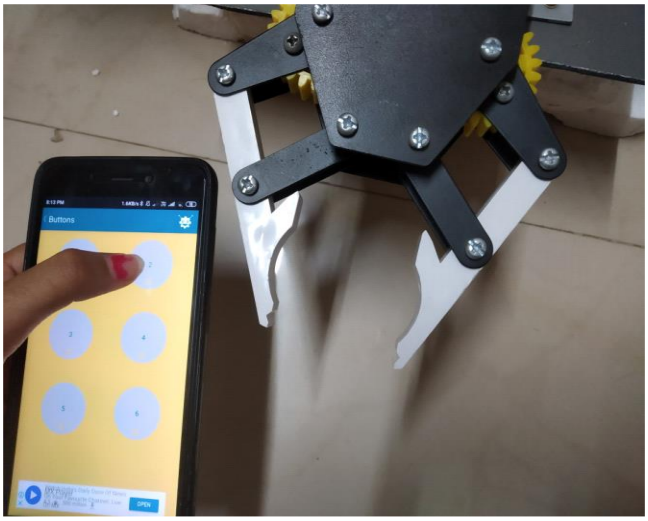

Fig. 3.3 Snap shot of opening the arm

Fig. 3.4 Snap shot of forward moment of wheels

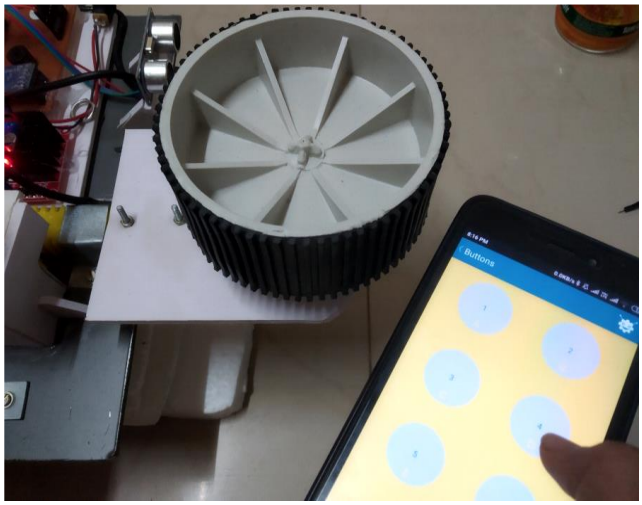

Fig. 3.5 Snap shot of reverse moment of wheels

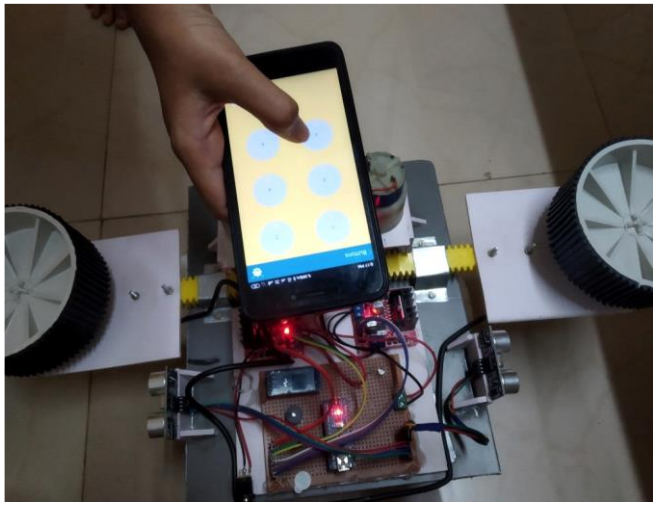

Fig. 3.6 Snap shot of expanding of rack & pinion gears

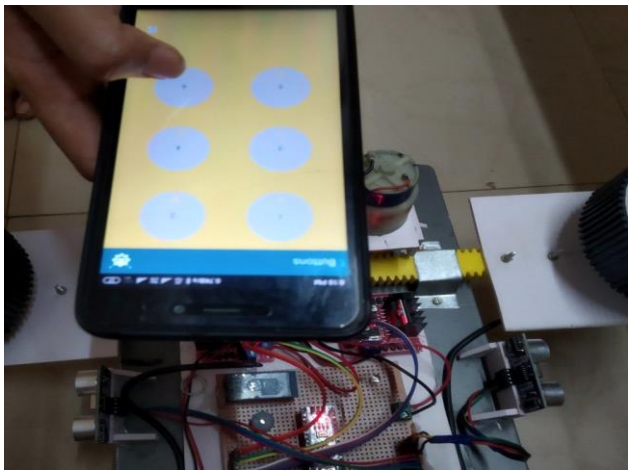

Fig. 3.7 Snap shot of compressing the rack and pinion gears

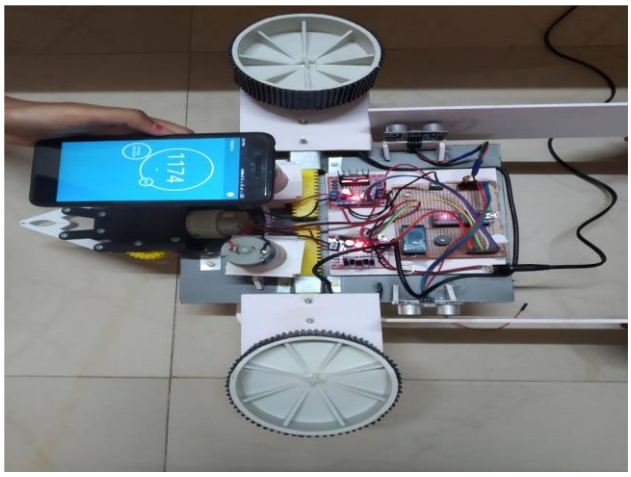

Fig. 3.8 Snap shot of reading data coming from ultrasonic sensor

VI. CONCLUSION

In conventional methods of recovering the child may take hours together to rescue victims. By this time the victim may lead to death, so an android based robotic system has been designed. The robots can perform the task with more accurate, faster and maintain consistency compared to humans. Many robots will make use of RF technology to recover the child from the pit but in the proposed system wireless communication technique has been employed to control the robot using Bluetooth technology.

REFERENCES

[1] Mohith Kurukuti, Mahesh Jinkala, Purushotham Tanjeri, Somasekhar Reddy Dantla and Mallikarjuna Korrapati, "A Novel Design of Robotic System for Rescue in Bore well Accidents" International Conference on Robotics and Automation for Humanitarian Applications (RAHA), 2016.

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