ARDUINO CONTROLLER BASED CHILD RESCUE SYSTEM FROM OPEN BOREWELLS

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***ABSTRACT*— In recent times, many toddlers fell into the borewell due to the negligence of the person who dig borewells and leave it without closing with the help of the lid. Because of the open borewell, there are numerous risks involved in human and animal survival. Borewell is a deep hole specially drilled to make use of groundwater for agricultural and household purposes. The width of a domestic borewell ranges from 4 inches to 12 inches (10.16 cm to 30.48 inches) and width of an industrial borewell varies from 12 inches to 24 inches (30.48 inches to 60.96 cm). According to the data given by the National Crime Records Bureau, a total of 39 toddlers have fallen into borewells between the years 2015-2020. Generally, the borewells are so narrow that a child get stuck in between, causing many injuries which in turn makes the child's life at risk. It is very complicated for an adult to find a way into the borewell and rescue the child. The rescue operation can be challenging and time-consuming needing a distinctive rescue crew. So, we have executed this project in such a way to rescue the child with the help of a machine which the adult can control without getting into the borewell. With the help of Arduino-based sensors, accelerated and productive rescue movements can be taken.**

***Index Terms*— Borewell; Child Rescue System; Arduino-Based Control**

I.INTRODUCTION

The Borewell project is done to access the underground water for miscellaneous purposes. Groundwater water is stored in the pores and spaces between rock and soil grains. Borewell is dug utilizing specific mechanisms. Borewell is made very deep based on the necessity, terrestrial environments, and the region. There are three types of borewells, they are Agriculture, Industry, and Domestic use. Borewell is a very important source of water. It is very important to ensure that the open borewell are closed to prevent the toddlers from falling into the borewell. The Borewell child rescue system is used to rescue a child who has tumbled into the borewell. When a child falls into the borewell, the child's health conditions enhance worst. They suffer dehydration, injuries, or a lack of oxygen. It is a multi-task approach, it includes local authority, police, firefighter unit, medical crew, and so forth. The rescue process includes many steps. They are evaluating the encircling surroundings. With the help of our project, we can rescue the child, prevent further accidents by securing the area and providing next-first-contact medical care.

The objective of our project is to help the child who is stuck in the borewell and to pull the child fast and

efficiently out. Most importantly, the child should be pulled up without dropping the harness. When the carbon dioxide is more it will create an encircling atmosphere depleting the oxygen. Because of this, suffocation takes place. The gas sensor displays the presence of CO2 when the threshold is more. When it is more, an oxygen supply is given to the child. The temperature, humidity, CO2 vicinity, and human presence can be deducted and the values of these parameters can display in the smartphone with the help of the IoT Blynk App. A camera is sent into the borewell to check the movement of the child.

II. LITERATURE SURVEY

For finalizing the objective of our project work we have reviewed the following research papers majorly being related with the technology which we have used in our project work "Borewell Child Rescue System", apart from books and websites. Kavianand. G [1] describes the designing of a system for rescue a child from bore well. This system is capable of moving inside the bore well. This Smart Child Rescue System consists of PIR sensors which help to sense only humans irrespective of the external conditions. In this system Raspberry pi is used which is costlier than Arm microcontroller. It requires more peripherals. Nish Mohith Kurukuti [2] describes the rescue operations without human intervention. The system can adjust its legs according to the pipeline dimensions. The system consists of power supply, actuators, dc and servo motors. The child position is captured from bore well with Camera module and monitored on PC. The ultrasonic sensor is interfaced with Arduino. The Arduino uses only microcontroller, hence we cannot get a video output or Ethernet port, like application processor it cannot run any operating system on it. Y.Manish Raj [3] describes the diameter of the narrow borewell for any adult person because light goes dark inside it, the rescue task is challenging. The systematic design attaches a harness to the child using pneumatic arms for picking up. A teleconferencing system is also attached to the system for communicating with the child. N. Bourbakis and I. Papadakis-Ktistakis [4] describes design of two complementary role to existing larger systemic structures, which mainly perform different rescue tasks. This is under development by a research team consisted of researchers from the ATRC-WSU (micro-design, software), the Ohio State University (microantennas). Micro-systemic structures in an effort for assisting the detection of human under debris and rescue them. These microstructures will play. K. P. Sridhar C. R. Hema S. Deepa [5] described a wireless sensor fusion system in the mechanical gripper systemic arm to assist the rescue operation and paramedical team effectively. Multiple sensors are interfaced to the wireless sensor fusion system to acquire the important parameters such as humidity, temperature, CO, and other gaseous levels from the bore well to monitor the condition of the child inside the bore well. In this system pic-microcontroller is used which has low speed operation than Arm processor. Preedipat Sattayasoonthorn and Jackrit Suthakorn[6] described a battery management for rescue system is summarized in this paper as a guideline for new developers. This paper covers the topics of power consumption, battery selection, battery charging/ discharging and battery maintenance but this system requires more hardware and also its design is complicated so this system is costly. Wang Chuanjiang [7] described the framework of rescue system is just simple, it is composed of rescue mechanism, anchorage set, hoist set, manipulator, frame work, control and communication system. The system can undertake the rescue tasks for small calibre wells, whose diameters can change from 1m to 0.3m by replacing some mechanisms.It requires more hardware. Palwinder Kaur , Ravinder Kaur, Gurpreet Singh [8] made an autonomous system having self-moving and self-sustaining capacity. Wheeled leg mechanism is employed in this design to go inside the pipe. The legs are circumferentially and symmetrically spaced out 120 apart. LM-35 Temperature Sensor and 16X2 LCD are interfaced with PIC 16F877A microcontroller to sense the temperature inside the bore well and to display it respectively. K. Saran, S. Vignesh, Marlon Jones Louis [9] 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. B. Bharathi, B. Suchitha Samuel [10] have done a wirelessly controlled system using Zigbee technology and dc motor-based gripper operation for systemic arm. This prototype uses PIC 16F877A microcontroller in the operation of rescuing the child. The system is operated through PC using wireless Zigbee technology and using wireless camera we can view both audio and video on the TV.

III. EXSISTING SYSTEM

In the existing system of borewell child rescue system, the parallel pit method is used. Usually, this method is followed to rescue the child from the borewell. The depth of the borewell where the infant is stuck is found out with the help of a rope. The earth-moving vehicles are used to dig the parallel pit adjacent to the borewell. It is a timeconsuming process. While unearthing the

borewell, the child concedes the possibility of suffering from suffocation. It makes the rescue team face more complications.

There is another method, a lightweight machine is sent into the borewell to take the toddler outside. It is operated through a PC using wireless Zigbee technology. Sometimes, both methods to rescue the child face deterioration.

IV.PROPOSED SYSTEM

In order to rescue the child, elementary arrangements are essential to understand. First is to analyse the situation like the depth of the borewell, health conditions of the child, etc that can help the rescue crew to execute the plan in efficient and speedy conduct. Second is to seal the encircling field in order to prevent further accidents and complications. Third is to call the rescue crew in order to take the child out from the borewell. The rescue group involves prepared professionals such as firefighters, medical staff, etc. It is important to note that rescuing a child from a borewell is a completely complex and hazardous task. Fourth is to use our project which can record the child's health conditions and other circumstances. Fifth is to dig a

parallel hole adjacent to the borewell if the situation is more complex. Sixth is to check the overall health conditions of the child by specialized doctors.

Adapter is connected to the Arduino UNO. So, when the adapter is connected to the Arduino, the 12V is given to the power supply board. LM 7812 is a regulator which is present inside the power supply board that will convert 12V into 5V. The 5V is supplied to the DHT11, PIR sensor, Gas sensor, and Node MCU. These mentioned devices will work only in 5V because of their maximum operating voltage. The three relays are given 12V which is coming directly from the power supply. In which two of the relay's output is the motor. One of them is forward biased and the other is reversebiased. The forward-biased relay helps in the downward movement of the child and reverse biased relay helps in the upward movement of the child. Whichever movement is necessary these relays are used. The third relay is connected to the oxygen supply unit which is in forward bias. The fourth relay is connected to the motor which is used to hold the child which is stuck inside the borewell. The oxygen unit is supplied to the child, when necessary, alone. The Node MCU is a Wi-Fi microchip that connects the phone and the device. The Node MCU acts as a server and the phone acts as a client. The phone can be used to operate the device by two apps namely Blynk IoT and Iot_Blynk. The Blynk IoT app can be used to turn on/off the motor and the oxygen unit. The Iot_Blynk app is used to view the child's position using the miniature camera. Suppose a child is stuck in the borewell, this device is used to save the child. First, the miniature camera is sent to check the position of the child. The PIR sensor is used to check whether the child is there or not. The Gas sensor helps to detect excess CO2. If CO2 is more, the oxygen tube is sent inside the hole for respiration. The motor which is connected to the relay helps to take the child out of the borewell.

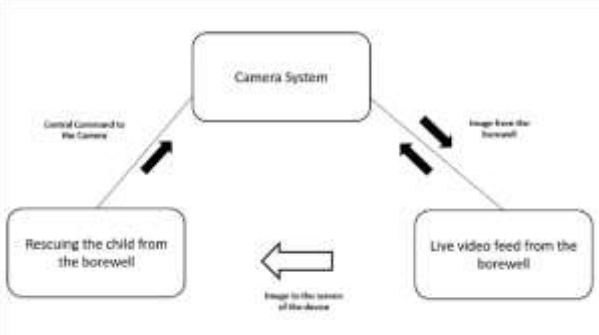

Fig. 1. Proposed Flowchart of Borewell Child Rescue System

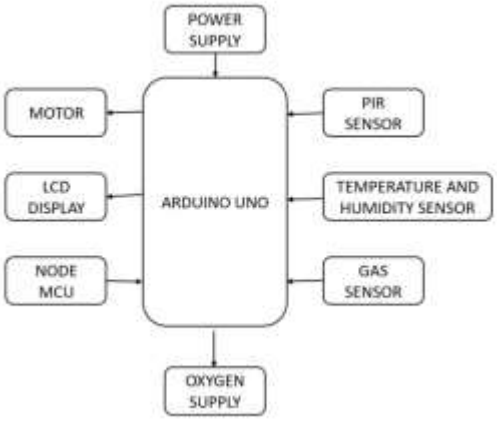

Fig. 2. Proposed Block Diagram of Borewell Child Rescue System

A. PIR DETECTION:

PIR sensors are used to sense whether the child is present inside the borewell or not. Humans emit infrared radiation in the form of heat which can be measured using this sensor. PIR sensor is very small, efficient, low-priced, it uses low power and doesn't wear out that easily. It can detect both human and animal movement. PIR sensor is made up of a pyroelectric sensor that can sense the infrared radiation which is coming from the child. It only detects and doesn't emit any energy.

B. GAS DETECTION:

For Gas detection, we have used an MQ-135 Gas sensor which is also known as Air Quality Sensor. This sensor is generally used by the pollution department to detect the presence of carbon dioxide. It can also detect gases like Ammonia, sulfur, Benzene, CO2, and other harmful gases and smoke which can cause serious health issues in humans. When the level of carbon dioxide gases goes beyond a threshold limit, the digital pin of the Arduino UNO. The digital goes high indicating the presence of high carbon dioxide levels.

C. TEMPERATURE AND HUMIDITY DETECTION:

The DHT11 is known as a digital temperature and humidity sensor. The temperature sensor is used to measure the temperature of the surrounding area. When the temperature is high, the child suffers hyperthermia which can cause an enhanced immune response, increased metabolic rate, dehydration, altered mental state, and damage to the tissue. When the temperature is low, the child suffers hypothermia which can cause decreased metabolic rate, shivering, confusion, fatigue, slowed breathing and heart rate, and organ failure. A humidity sensor is used to measure the amount of moisture or water vapor in the air. As the temperature rises, the air can hold more moisture which can increase the humidity. The overall sensor uses a thermistor and a humidity sensor to measure the surrounding air.

D. CAMERA AUTHENTICATION:

ESP32-CAM is used to see the child's condition inside the borewell. It is a full-featured microcontroller. It has an integrated video camera and microSD card socket. It can also be used in image tracking and recognition. The child's movement is shown in the IOT_BLYNK App.

V.IMPLEMENTATION

The proposed system utilizes various components, including a relay, motors, a PIR sensor, a temperature and humidity sensor, a gas sensor, a node MCU, an LCD display, an Arduino UNO, an Oxygen unit, IOT Blynk App, and a Camera.

A. RELAY:

The relay is a switch-based operated circuit. It protects the whole device from damage. When the motor receives more current, the condition is referred to as overload. It can cause overheating and damage the windings of the motor. In this project, we used four relays. The first relay is used for the upward movement of the child from the borewell which is a backward relay. The second relay is used for the downward movement of the child which is a forward relay. The third relay is used for the ventilator which is the forward relay. The fourth relay is used to hold the child.

Fig 3: Relay

B. MOTOR:

An electric motor is a machine that is used to convert electrical energy into mechanical energy. When the electric and magnetic field meets each other, the force is created known as torque which causes the motor to rotate either in a clockwise direction or an anti-clockwise direction. In this project, three motors are used. The first motor is used for the upward and downward movement of the child stuck in the borewell. The second motor is used for the ventilator which helps the child to receive oxygen. The third motor is used to hold the child which can provide a grip to lift the child upward.

Fig 4: Motor

C.PIR SENSOR:

PIR sensor is abbreviated as Passive infrared sensor. This sensor allows us to sense motion. Humans emit infrared radiation in the form of heat which can be measured using this sensor. PIR sensor is very small, efficient, and low-priced, it uses low power and doesn't wear out that easily. It can detect both human and animal movement.

PIR sensor is made up of a pyroelectric sensor that can sense the infrared radiation which is coming from the child. It only detects and doesn't emit any energy. In this project, we used a PIR sensor to detect whether the child is present in the borewell or not.

Fig 5: PIR Sensor

D.TEMPERATURE AND HUMIDITY SENSOR:

The DHT11 is known as a digital temperature and humidity sensor. The temperature sensor is used to measure the temperature of the surrounding area. A humidity sensor is used to measure the amount of moisture or water vapor in the air. As the temperature rises, the air can hold more moisture which can increase the humidity. . The overall sensor uses a thermistor and a humidity sensor to measure the surrounding air.When the child is stuck in the borewell, the oxygen will be very less and carbon dioxide will be more. When carbon dioxide is more, naturally the humidity will increase leading to breathlessness.

Fig 6: DHT11

E.GAS SENSOR:

For Gas detection, we have used an MQ-135 Gas sensor which is also known as Air Quality Sensor. This sensor is generally used by the pollution department to detect the presence of carbon dioxide. It can also detect gases like Ammonia, sulfur, Benzene, CO2, and other harmful gases and smoke which can cause serious health issues in humans. When the level of carbon dioxide gases goes beyond a threshold limit, the digital pin of the Arduino UNO. The digital goes high indicating the presence of high carbon dioxide levels. In this project, when the concentration of CO2 reaches 1500-2000 PPM (3-8%) it can cause headache, dizziness, difficulty breathing and the digital output pin goes high.

Fig 7: MQ135

F. NODE MCU:

Node MCU is also known as Micro Controller Unit .It is an open source environment for both software and hardware development (ESP8266).It contains crucial elements of the computer: CPU, RAM, networking (WiFi: IEEE 802.11x term) and modern operating system & SDK. In this project, Node MCU is used as the server to connect the smartphone which is a client to execute commands like turning the motor on and off.
It is also used to control the camera.

Fig 8: Node MCU

G.LCD DISPLAY:

LCD stands for liquid crystal display. It is an electronic display module used in various appliances. It is mainly preferred for multi-segment light emitting diodes and seven segments. In this project, we have used LCD to

display various parameters like Temperature, Humidity, CO2 and
Human movement

Fig 9: LCD

H. ARDUINO-UNO:

The Arduino UNO is a standard board of Arduino that we have used in this project. UNO means one in Italian. It is actually based on ATmega328P microcontroller. The board basically consists of both digital and analog pins which has Input and Output pins (I/O), shields, and other circuits. The Arduino UNO includes 6 analog inputs, 14 digital inputs, a USB connector, a power jack, and an ICSP (InCircuit Serial Programming) header. It is programmed based on IDE, which is abbreviated as Integrated Development Environment. In this project, the Arduino helps to command various sensors to perform work. When the power is supplied, the working Arduino starts. The analog pins are used to command the work and digital pins are used to record the values that various parameters measure. These required values are sent to the Node MCU so it can connect to the smartphone to display the values

Fig 10: Arduino UNO

I.OXYGEN UNIT:

Oxygen is a very important component of the human being in order to survive. The measurement of oxygen is based on SpO2 or peripheral capillary oxygen saturation which can show the percentage of oxygen that is bound to the hemoglobin in the blood. A healthy person's SpO2 level should be above 95%. If it drops to 90% it can cause suffocation which can lead to various problems. When this level is reached, an oxygen supply is given to the child.

Fig 11: Oxygen Unit

J.IOT BLYNK APP:

Arduino UNO is used as a server and bridge connected to the internet. Node MCU is used as a link between equipment and sensors with Arduino UNO. Node MCU reads sensor data and sends it to the server. The smartphone requests the server to respond that have been installed by the Blynk framework.

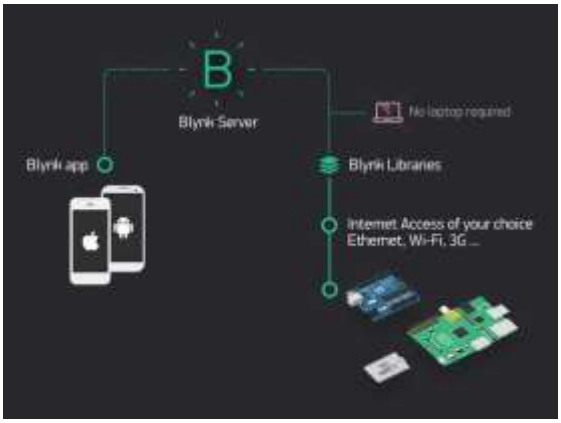

Fig 11: IOT BLYNK App

K. CAMERA

ESP32-CAM is used to see the child's condition inside the borewell. It is a full-featured microcontroller. It has an integrated video camera and microSD card socket. It can also be used in image tracking and recognition. The child's movement is shown in the IOT_BLYNK App.

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Fig 12: ESP32-CAM

VI. RESULTS:

All the objectives which are discussed in our paper are successfully implemented to save the child's life.

Our proposed system is capable to save the child which is stuck in the borewell. It is a well-advanced project than the existing system. Moreover, it is very efficient in saving the child in a quick manner. The system is light-weighted. The sensors used in this project are more advanced than the existing system. Saving a child's life is a very complex process and our project can save the child's life.

Fig 12: Borewell Child Rescue System

All the parameters will be normal at the ground level. But inside the borewell, the parameters will change. To save the life of the child and rescue quickly we can detect the parameters like Carbon dioxide, Temperature, and Humidity.

CASE 1: Parameters when the system is outside the borewell

PARAMETERS	RANGE
Carbon Dioxide	400 ppm
Temperature	25-35 C (Based on the environment)
Humidity	40-60%

CASE 2: Parameters when the system is inside the borewell

PARAMETERS	RANGE
Carbon Dioxide	1000 ppm
Temperature	50 C
Humidity	90%

VII. CONCLUSION

Human life is always valued. It is the duty of every citizen to help and protect the individual who is in need of help. Our borewell rescue system can help the child's existence. It can successfully save a toddler's life who has fallen into the borewell. This project has an off-course opportunity in production industries and additional corporations. We can save the child in a quick and efficient way.

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