“Borewell Rescue Ranger Device”

Submitted in partial fulfillment of the requirements

of the degree of

Bachelor of Engineering

by

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VIVA INSTITUTE OF TECHNOLOGY

University of Mumbai

(2022 – 2023)

CERTIFICATE

This is to certify that the project entitled **"Borewell Rescue Ranger Device"** is a bonafide work of **"Omkar Subhash Bari"** (UCN No. MAD2005), **"Kunal Arvind Bhoir"** (UCN No. MAD2010), **"Laukik Pravin Jahir"** (UCN No. MAD2036), **"Arun Kumar Maurya"** (UCN No. MAD2059) submitted to the University of Mumbai in partial fulfillment of the requirement for the award of the degree of "**Bachelors of Engineering**" in "**Mechanical Engineering**".

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Project Report Approval for B. E.

This project report entitled "**Borewell Rescue Ranger Device**" by "**Omkar Subhash Bari**", "**Kunal Arvind Bhoir**", "**Laukik Pravin Jahir**", "**Arun Kumar Maurya**" is approved for the degree of "**Bachelor of Engineering**" in "**Mechanical Engineering**".

Examiners

1._____

2._____

Date:

Place: Virar

Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Abstract

A technique for rescue task in bore well environment has been proposed. India is facing a distressed cruel situation where in the previous years a number of child deaths have been reported falling in the bore well. As the diameter of the bore well is quite narrow for any adult person and the lights goes dark inside it, the rescue task in those situations is a challenging task. Here, a robotic system is being proposed which will attach a harness to the child using pneumatic arms for picking up. A teleconferencing system will also be attached to the robot for communicating with the child.

Living in the 21st century, one can see how science and technology are growing, but still, there are many problems that arise in many rural areas of India. “Once it was said that we can reach to moon and mars with the help of science and technology, but why are we failing to reach the child that has been fallen into the borewell?” It involves a lot of energy and expensive resources which are not easily available everywhere and, in this process, big space around the trapped bore is always needed to dig a parallel bore. These approaches involve heavy risks, including the possibility of injuries to the body of the subject during the rescue operation.

After seeing into all the issues and cases, a serious fault has been found that the rescue team is failing to save the child in the borewell. So, looking into it, the idea of making a "Borewell Rescue Ranger Device" has been proposed, which will be a portable device that can be carried anywhere to the accident area to save the child in just minutes. Designing and manufacturing the "Borewell Rescue Ranger Device" will overcome the increasing accidental deaths of the children falling into borewells. This setup is very portable, low in cost and anyone can be able to carry it to the desired accidental location for rescue operation where a life is to be saved. The ESP8266 Wi-Fi Module and the mechanical lifter will be playing an important role in this mechanism, the principle of these is to send signals to the mechanical lifter that is to be unlocked after achieving the desired position to rescue the child in the borewell. Also, the mechanism will be equipped with camera so that to make the rescue operation very smooth and stable.

Keywords: Borewell robot, teleconferencing, harness, rescue, borewell, child, bore, method, operation, device, trapped, children, small.

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Organization of Report

The dissertation report of research work has been organized as follows:

Chapter 1 includes Introduction which gives the information about the cases happened in the past about the children falling into the borewells and have suffered a lot, and looking into this a decision of making a rescue device called borewell rescue ranger device.

Chapter 2 includes Literature Review where many research articles helped out to make this project successful and gain more knowledge about the inventions done in the past and are ongoing.

Chapter 3 includes Problem Definition and Objectives which gives a clear idea about what is the aim of the project and the problem that is to be solved of rescuing the child stuck into the borewell.

Chapter 4 includes Methodology which is been used to fabricate the project with its detailed calculations and programming.

Chapter 5 includes Result that we have obtained after testing the project by following proper methodology process.

Chapter 6 includes Conclusion where the whole concept of the project is concluded and detailed information about what can be done in future to upgrade the device are mentioned in future scope.

Chapter 1

Introduction

1.1 Project Background

As we all live in 21st century and see that how we are growing in science and technology, but some of the how there are still many problems that still arise in many rural areas of India. Once it was said that we can reach to moon and mars with the help of science and technology, but why are we failing to reach the child that has been fallen into the borewell. 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 will slip in and get trapped.

There is no proper way or technique to rescue these small lives from the borewell in minimum time period. It involves a lot of energy and expensive resources which are not easily available everywhere and, in this process, we always need big space around the trapped bore that we can dig a parallel bore. These approaches involve heavy risks, including the possibility of injuries to the body of the subject during the rescue operation. This traditional method of saving the child is a time taking and risky method, this traditional method is called as parallel pit method as shown in figure 1.1 and figure 1.2. Also, the general borewell dimensions are hereby represented in figure 1.3, 1.4, and 1.5. These images are taken with the reference from

the surveys made by Government of Chhattisgarh. The survey displays the general dimensions of the borewell and type of borewells present. This survey is named as Unified Schedule of Rates (Part – III) for Construction of Tube Wells and Allied Works.

After seeing into all the issues and cases we found a serious fault that is lacking the rescue team is failing to save the child in the borewell. So, looking into it we have come up with the idea of making a "Borewell Rescue Ranger Device" which will be a portable device that can be carried anywhere to the accident area to save the child in just minutes.

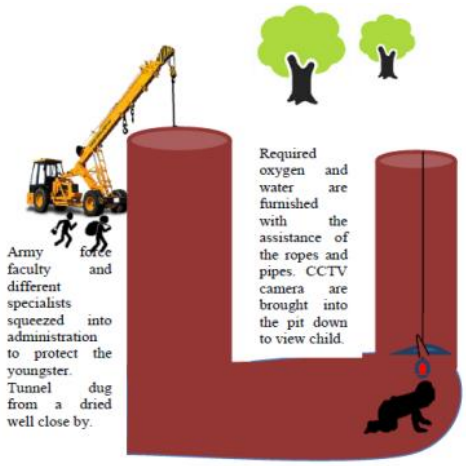

Figure 1.1 Parallel Pit Method

Figure 1.2 Traditional Borewell Rescue Method

The whole device is being attached to a pulley which is used hold the robot and sent it into the borewell for rescue operation. The Robot is equipped with motors, microcontrollers, sensors and cameras that help the operator to monitor the whole process and rescue the child from borewell. The motors engage the gripper that catches the child in the borewell. The general borewell dimensions are hereby represented by the following images :-

Information from the news article about the incidents of children falling into borewells, arguably the most talked about case in recent years, in 2006, a massive operation was launched to rescue five-year-old Prince Kumar Kashyap. He had fallen into a 55-feet deep borewell in a village in Haryana's Kurukshetra. Prince was pulled out safely nearly 48 hours later as the entire country watched with bated breath, hooked on to their TV screens. Over the next few weeks, Prince garnered celebrity status and often made appearances at yagnas and events around villages in Kurukshetra district [1].

There after a Five-year-old Mahi, fell to her death in a 60-foot abandoned borewell while playing with her friends. The girl could not be saved, despite a massive effort by army and district administration for five days. A huge rock was a major hurdle that the rescuers had been

struggling to break for three days. The slab was located in the horizontal tunnel between the borewell and the pit dug up to rescue the child [2].

Then in 2017 a seven-year-old boy, Sai Barhate fell into a borewell in Kopargaon tehsil of Maharashtra's Ahmednagar district. He could not be saved [3].

A one-and-half-year old boy, Nadeem, fell into a ten-inch wide and 55-feet deep borewell in Balsamand village of Hisar district in March 2019. The NDRF and the army were pressed into service and the toddler was finally rescued after a 48-hour long operation. Almost 40 JCB machines were pressed into service for digging a parallel pit and about 100 men from the Army and the NDRF participated in the operation apart from 150 policemen [4].

Seema, a four-year-old girl, slipped into a 440-feet deep borewell in Jodhpur's Melana village. Seema was stuck at a depth of 260-feet inside the borewell and her body was pulled out after a 14-hour operation. The tubewell at the farm had broken down and the girl's father had taken the pump out for repairing, leaving the borewell open [5].

A Two-year-old Fatehveer Singh fell into a 120-feet deep borewell in June 2019 while playing at Bhagwanpura village and despite rescue operations spanning 109 hours, he could not be saved. The borewell was once used by Fateehveer's family to irrigate the fields. A massive rescue operation was launched by NDRF to bring the child out safely. Officials managed to supply oxygen but no food or water could be provided to him [6].

A six-year-old boy fell into a 200-feet deep borewell in Pune district in February 2021 [7].

Six-year-old boy Ritesh Jawasingh Solanki fell into a 200-feet deep borewell in Nashik district on November 15, 2021. It took 16 hours for the police team to rescue him [8].

On June 9, a two-year-old boy fell into a borewell at a farm in Gujarat's Surendranagar district, following which a team of the army, fire brigade, police and health officials rushed to the spot and rescued him. On May 22, a six-year-old boy, who fell into a 100-feet-deep borewell in a village in Punjab's Hoshiarpur district died after a nine-hour-long rescue operation [9].

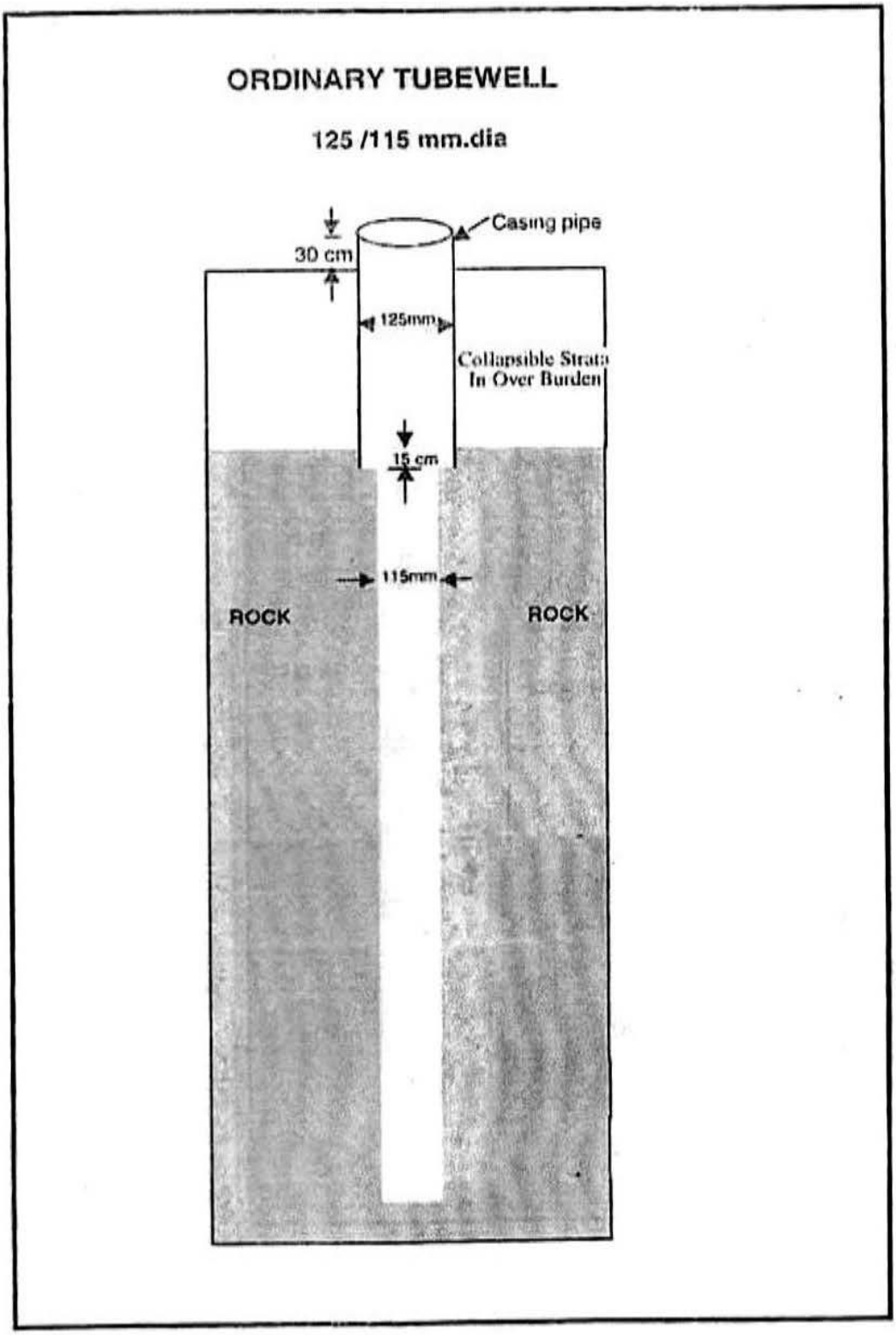

Figure 1.3 Ordinary Tube Well 125/115 mm diameter

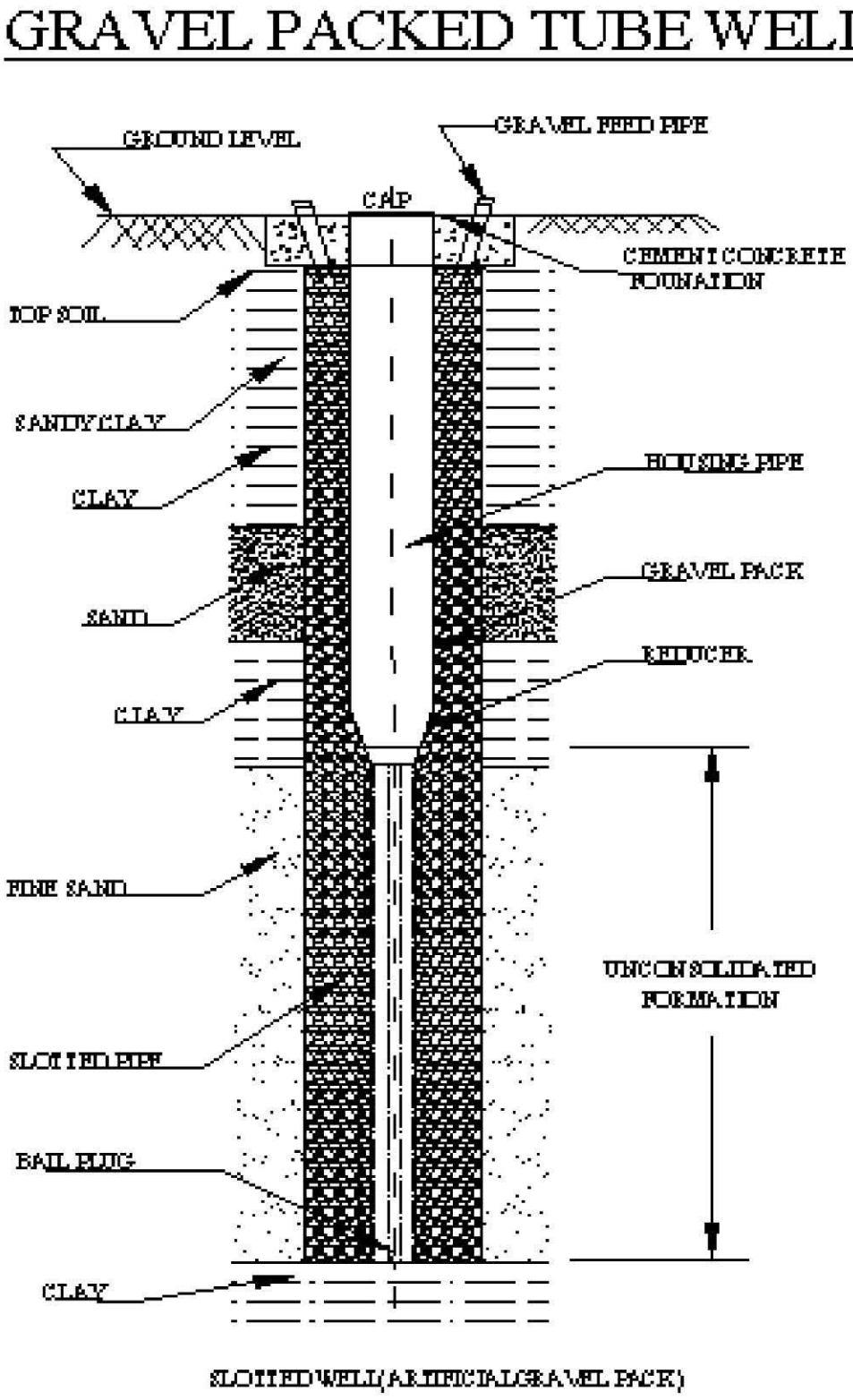

Figure 1.4 Gravel Packed Tube Well

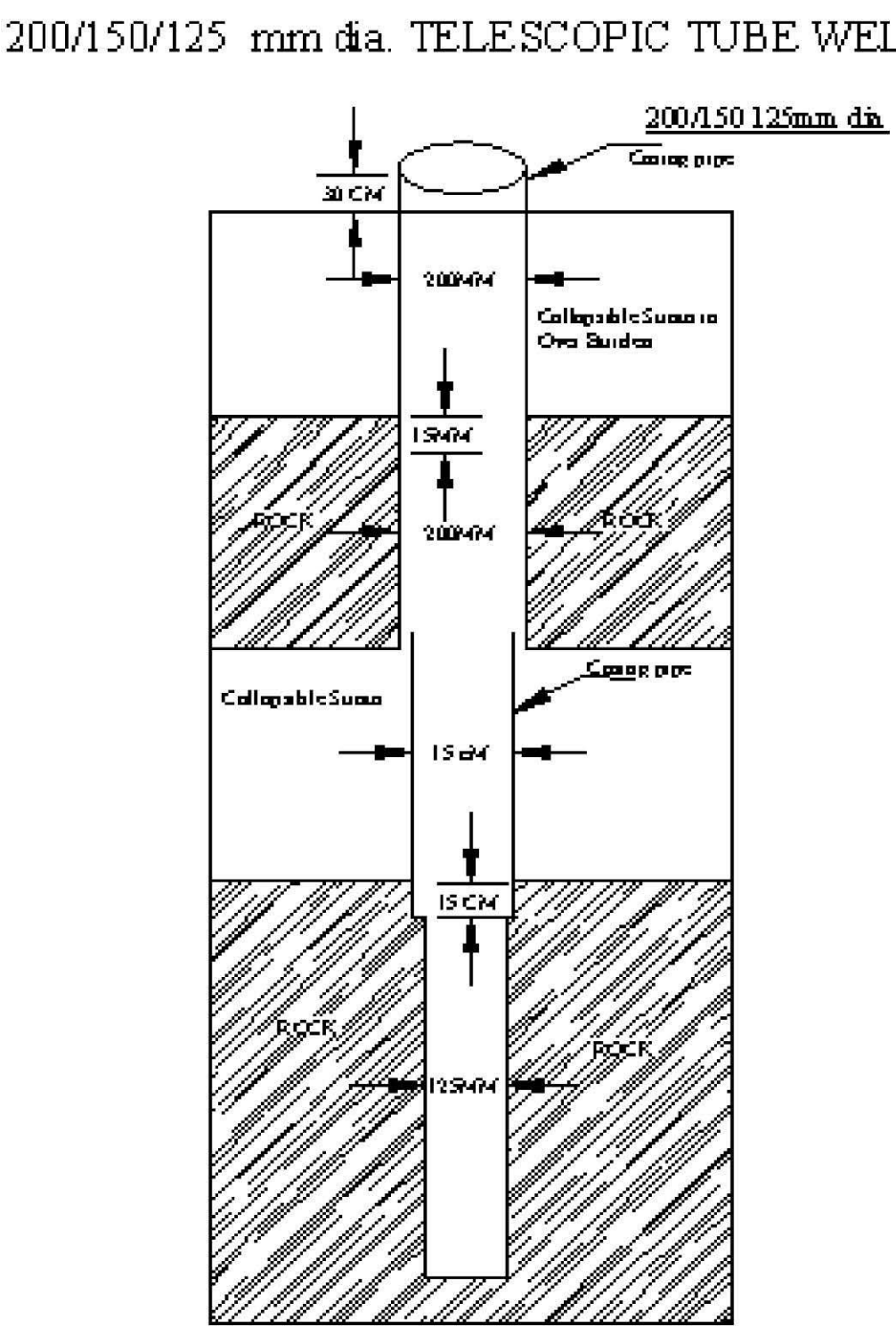

Figure 1.5 200/150/125 mm diameter Telescopic Tube Well

Chapter Summary

The chapter discusses the problem of children falling into borewells in rural areas of India and the difficulties faced by rescue teams in saving them using traditional methods. It cites several incidents where children fell into borewells and were either rescued after long and risky operations or lost their lives. The article proposes a solution in the form of a portable device called the "Borewell Rescue Ranger Device", which is equipped with microcontrollers, sensors, and cameras to rescue the child in a shorter time frame. The device is attached to a pulley and sent into the borewell for the rescue operation. The article highlights the need for such a device as traditional rescue methods are time-consuming and risky.

Chapter 2

Literature Review

2.1 Review

In this chapter we have done some research on our project topic. We found many articles and journals regarding our project model, and we have tried best to implement the knowledge gained from these research papers into our project. The papers we found very useful are mentioned below:

Jayasudha.M, et.al, 2019 [10] In India for recent years, water scarcity is the principal inconvenience. To overcome these issues, people initiated to burrow bore well. In our nation, the vast majority of the people are agrarian and they depend on the water for irrigation system. Children involuntarily fall into the bore well which yielded water and left revealed. The process of saving the trapped child into bore well is relatively challenging. At present, the rescuing task is accomplished by the method for burrowing a parallel pit close to the bore well with the same depth of the child and makes a passage that interfaces with the two wells. It takes about 30 hours to burrow the new well. By that period the child would have passed on. To overcome this

concern, a well-planned robot is designed in a unique way, that it saves the stuck child and also it observes the child carefully by using web cam within a short time span. It consists of two modules which are rescuing system and protection system. The protection system is with the guide of setting an air sack at the base of the passage and recovers the child at the base of the passage and recovers the child at any rate of gripper disappointment. The safeguarding instrument is about a robot gadget fit for moving underneath the bore well bolstered with their user directions, equipped with robot arm, unrestrained objectives modernized camera, high resolution LED. The robot arm is utilized to fix the belt to the trapped children. The belt is hook.

Rajarathnam D.R.P, et.al 2018 [11] The bore well accidents are now become common everywhere. Frequently we hear news on child stuck in the bore well, some are being rescued and, in some cases, we lose to save the life of the child. The main objective of this project is to design and construct a portable robot which is cost effective, quick in action and accurate. The Bore well Rescue Robot is capable of moving inside the well and performs operations according to the user commands. The proposed model is designed to provide the child with two level of safety achieved by using robotic holding at the top and safety airbag at the bottom. This arrangement ensures that the child does not slip further deep during the rescue operation. The robot is operated by the human manually and monitor in computer. According to the observations made continuously using CCTV camera.

V. Venmathi, E. Poorniya, et.al, 2015 [12] The aim of this project is to give an innovative concept to handle the bore well rescue operations. Nowadays child often falls down in the borehole which is left uncovered and get trapped. It is difficult and also risky to rescue the trapped children to aid in such rescue we proposed a system of designing robots to the rescue of a child in a borehole. The robot structure consists of power supply, switch pad, gear motors, Oxygen concentrator, camera and Microcontroller. The condition of trapped child is captured with CCTV camera and monitored on a TV. A safety balloon is introduced in order to provide extra safety. Once the lifting rod reaches a safe position under the child, an air compressor is operated to pump air to the bladder attached to the end of the lifting rod through an air tube that runs downwards inside the lifting rod. The bladder provides a safe seating to the child. When the child is secure, the lifting rod is contracted to its maximum position. The motor is then reversely operated so as to unclamp the system. Simultaneously, it is lifted out of the well using a chain or rope. The programming language is Embedded C which is executed by MP lab Integrated Development Environment. This robot type machine can rescue trapped body from the bore well in a minimum amount of time and safety.

Elsa Babu, Emily Eldo, et.al, 2015 [13] Nowadays cases of children getting trapped in unused bore wells are increasing. The rescue of such children becomes difficult due to lack of proper awareness about the health condition of the children trapped in bore well. Even the depth at which child is trapped makes the rescue work a difficult. The present system uses releasing cameras into bore wells by means of tugs to get information about the victim which won't give reliable results. 'The Rescue Robot' is a creative innovation that solves these problems in rescue field up to a certain extent. This is a 3-wheel robot capable of moving vertically upwards & downwards by means of motors in bore wells. The motion is controlled by a remote Laptop via ZigBee module. The objectives of the project include wireless controlling of Robot through PC using Zigbee technology, live audio and video reception and implementation of pick and place concept to the robot.

Sridhar, K. P., And C. R. Hema, 2015 [14] Modelling and analysis of gripper arm system for bore well rescue operations and a humanoid model is designed to test the various parameters inside the well at various stages of time and places (humidity, temperature, pressure, oxygen, atmospheric air supply, speech ability, carbon dioxide, carbon level) and the rescue device is tested for its holding capacity.

Manish Raj, G. C. Nandi, et.al, 2014 [15] A technique for rescue task in bore well environment has been proposed. India is facing a distressed cruel situation where in the previous years a number of child deaths have been reported falling in the bore well. As the diameter of the bore well is quite narrow for any adult person and the lights goes dark inside it, the rescue task in those situations is a challenging task. Here we are proposing a robotic system which will attach a harness to the child using pneumatic arms for picking up. A teleconferencing system will also be attached to the robot for communicating with the child.

G. Nithin, G. Gowtham, et.al, 2014 [16] 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 umpteen 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. Very few of the victims have

been saved in such accidents. Recently some autonomous robots came on to screen to take out the trapped body in a systematic way. But the question rises, why these bots are not in action in the real world. This brings out safety that how far the robot handles the child safely. The rescue operation mainly consists of three processes; Approaching the Child, Handling the body, Taking child out of the well. A regular autonomous robot could easily perform the first and third operations. These bots can make up these two steps within few minutes. But there is a great chance for injury of victim as they try hooking up body organs and cloths. Our Project deals with extreme Safe Handling of the victim. The design of handling system is made in such a way that the baby/victim never gets hurt and the robot itself provides some pretreatment to make the baby survive till the end of operation. Our robot design constitutes a best Ergonomic Design and performs safest rescue operation.

J. Casper and R. R. Murphy, 2013 [17] The World Trade Center (WTC) rescue response provided an unfortunate opportunity to study the human-robot interactions (HRI) during a real unstaged rescue for the first time. A post-hoc analysis was performed on the data collected during the response, which resulted in 17 findings on the impact of the environment and conditions on the HRI: the skills displayed and needed by robots and humans, the details of the Urban Search and Rescue (USAR) task, the social informatics in the USAR domain, and what information is communicated at what time. The results of this work impact the field of robotics by providing a case study for HRI in USAR drawn from an unstaged USAR effort. Eleven recommendations are made based on the findings that impact the robotics, computer science, engineering, psychology, and rescue fields. These recommendations call for group organization and user confidence studies, more research into perceptual and assistive interfaces, and formal models of the state of the robot, state of the world, and information as to what has been observed.

Chapter Summary

The chapter discusses the different approaches for designing and constructing robots to rescue children who fall into bore wells in India. The lack of water in India has led to many people relying on bore wells, which can often be left uncovered and pose a danger to children. The robots are designed to provide a quick and safe rescue operation. They use various techniques such as airbags, CCTV cameras, robotic arms, and pneumatic arms to rescue children from bore wells. The robots are operated either manually or remotely using ZigBee technology. The aim is to provide a cost-effective, quick, and accurate way to save children who get trapped in bore wells.

Chapter 3

Problem Definition

3.1 Problem Statement

This project is not been made for the first time, previously the inventor from Gujrat tried to make this project and was successful in his attempt and made a working model of rescue machine. But there is a major problem in his device that the technique of lifting the child that has been fallen into the borewell is such a way that a grabber grabs the child by its neck which is found risky and can cause threat to the child.

By looking into this a decision is made to change the grabbing technique to lifting technique. Our project model is equipped with a mechanical lifter which will go underneath the foot of the child to lift it straight without causing damage.

3.2 Objectives

- To replace the grabber technique of the model existing with a lifter mechanism.
- To make it light weight, strong, cost friendly and portable.
- To reduce the operating time that is required to rescue the child from the borewell.

Chapter Summary

The problem statement of the project is that a previous inventor from Gujarat had created a rescue machine with a grabber to retrieve children who fall into borewells, but the grabber poses a risk to the child. The objective of this project is to replace the grabber technique with a lifting mechanism that goes under the child's foot and lifts them straight up without causing harm. The project also aims to make the machine lightweight, strong, cost-effective, and portable while reducing the rescue time.

Chapter 4

Methodology

4.1 Methodology

Designing and manufacturing the “Borewell Rescue Ranger Device” will overcome the increasing accidental deaths of the children falling into borewells. This setup is very portable and anyone can be able to carry it to the desired accidental location for rescue operation where a life is to be saved.

The ESP8266 Wi-Fi Module and the mechanical lifter will be playing an important role in this mechanism, the principle of these is to send signals to the mechanical lifter that is to be unlocked after achieving desired position to rescue the child in the borewell. Also, our mechanism will be equipped with ESP32 Camera to monitor the conditions inside the borewell so that to make the rescue operation very smooth and stable. Methodology process is been carried out as per the given flow chart as shown in figure 4.1.

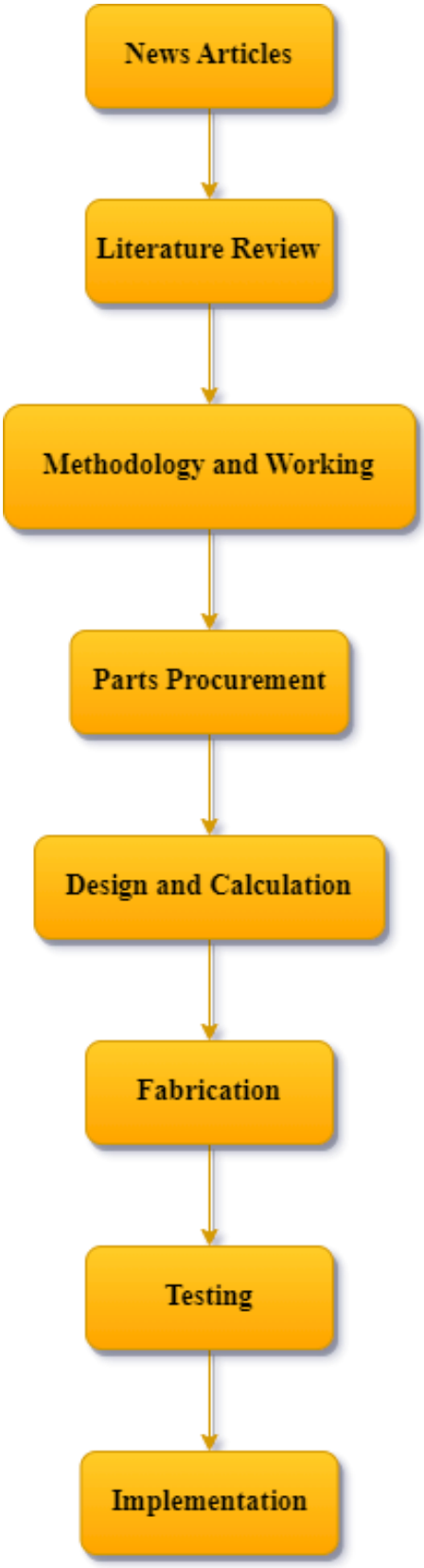

Figure 4.1 Steps Involved in Proposed Methodology

4.2 Parts and Specifications

This topic covers the information about the parts and material that are to be used to fabricate the project with their specifications mentioned in table 4.1.

Table 4.1 Parts and Specifications

Sr. No.	Parts	Specifications
1.	Metal Plates	Mild Steel (MS)
2.	Metal Pipes	Mild Steel (MS)
3.	Wireless Module	ESP8266 Wi-Fi Module
4.	LED	5V Addressable LED Strip
5.	Camera Module	ESP32 Camera Module
6.	Battery	12 volts DC
7.	App	Blynk IoT
8.	Wires & Cables	As Per Requirement

4.2.1 Wireless Sensors

The Wi-Fi Module (ESP8266 Wi-Fi Module) as shown in figure 4.2 will help is to operate the device operations wirelessly by using mobile phones or laptops/pc. The reason behind choosing ESP8266 Wi-Fi Module for the project because it is a powerful and versatile platform that can be used for a variety of projects. Here are some reasons why you might choose to use an ESP8266 Wi-Fi module. The ESP8266 is designed for WiFi connectivity and is able to connect to wireless networks, making it ideal for projects that require internet connectivity or communication with other Wi-Fi enabled devices. The ESP8266 is a relatively low-cost platform, making it accessible for hobbyists and DIY projects. The ESP8266 is a compact module that can be easily integrated into small projects and devices. The ESP8266 features a powerful processor that can handle complex tasks, making it suitable for a wide range of applications. The ESP8266 can be programmed using a variety of programming languages and environments, including Arduino IDE, Lua, and MicroPython, making it accessible to developers with varying levels of experience. The ESP8266 can be used for a variety of projects, including home automation, IoT (Internet of Things) devices, smart appliances, wireless sensors, and much more.

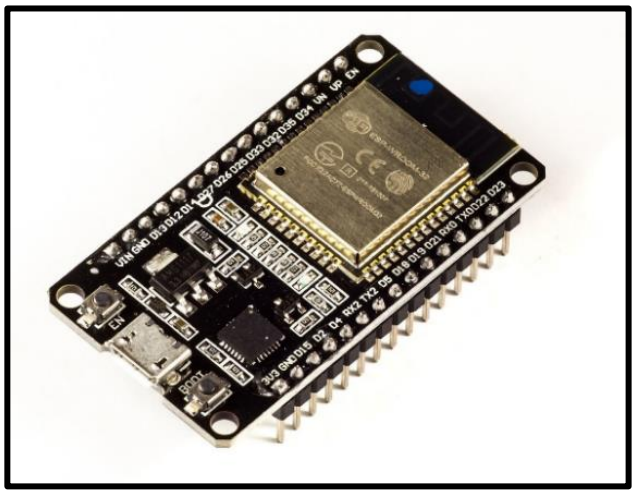

Figure 4.2 ESP8266 Wi-Fi Module

4.2.2 LED’s

For clear vision inside the borewell a 5V Addressable LED Strip as shown in figure 4.3 is included which will help the ESP32 Camera monitor conditions with better lighting. The 5v LED strip is chosen for the project because, a 5V LED strip operates at a lower voltage than most other LED strips, which typically run at 12V or 24V. This lower voltage can make it safer to work with and easier to power using a USB port or a small battery pack. A 5V LED strip requires less power to operate than a 12V or 24V LED strip, which can save energy and reduce electricity costs. 5V LED strips are generally less expensive than higher voltage strips, making them a good choice for those on a budget. Some microcontrollers and development boards, such as the ESP32, ESP8266 and Raspberry Pi Zero, operate at 5V, which makes a 5V LED strip a good match for these platforms. Hence, this LED strip is perfectly suitable for the rescue ranger device

Figure 4.3 5V Addressable LED Strip

4.2.3 ESP32 Camera Module

To keep an eye to the behaviour of the child in the borewell and observe the rescue operation the device also has a ESP 32 Camera Module (720p) as shown in figure 4.4. The project uses ESP32 Camera because, The ESP32 Camera module is a popular platform for live streaming video. The ESP32 Camera module features built-in WiFi connectivity, making it easy to connect to the internet and stream video wirelessly. The ESP32 Camera module is small and compact, making it easy to integrate into small projects or devices. The ESP32 Camera can capture high-quality video up to 720p resolution, making it suitable for a wide range of applications. The ESP32 Camera module features a built-in camera, which eliminates the need for an external camera and makes it easy to capture and stream video. The ESP32 Camera module features a powerful processor that can handle complex video processing tasks, such as encoding and streaming video. The ESP32 Camera module is relatively low-cost compared to other video streaming solutions, making it accessible for hobbyists and DIY projects.

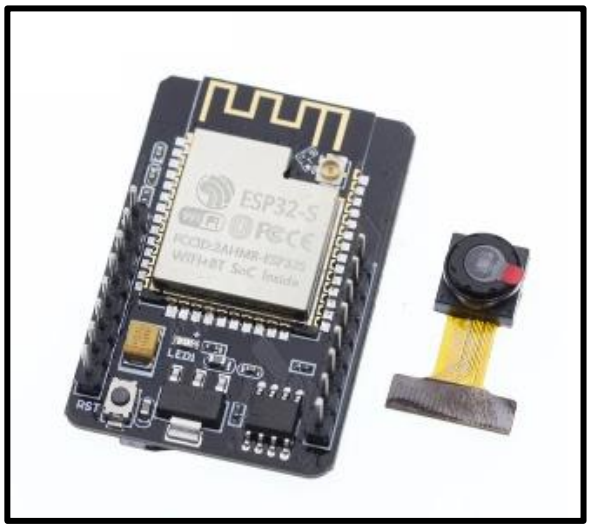

Figure 4.4 ESP32 Camera Module 720p

4.2.4 Battery

To power all the device setup there is an appropriate battery of 12 volts DC used as shown in figure 4.5. Here are some general specifications for the Amptek 12V lead-acid battery:

- Voltage: 12 volts
- Capacity: typically ranging from 1.2Ah to 100Ah, depending on the model
- Chemistry: lead-acid
- Maintenance: rechargeable and requires periodic maintenance such as checking the electrolyte level and ensuring proper charging conditions
- Weight: also varies depending on the model, but can range from around 0.8 pounds for a 1.2Ah battery to over 60 pounds for a 100Ah battery
- Terminal Type: generally, either F1 or F2 terminals, which are standard sizes for lead-acid batteries
- Cycle Life: can vary depending on the model and usage conditions, but lead-acid batteries typically have a cycle life of a few hundred to a few thousand cycles.

Figure 4.5 Battery

Amptek 12V lead-acid batteries have a high capacity, which means they can supply power for longer periods of time compared to other types of batteries. Lead-acid batteries can operate in a wide range of temperatures and environmental conditions, making them suitable for outdoor and industrial applications. Lead-acid batteries are generally less expensive than other types of batteries, making them a good choice for budget-conscious projects. Lead-acid batteries can be recharged multiple times, which means they can be used over and over again.

Lead-acid batteries are known for their reliability and long life span, making them a popular choice for applications that require uninterrupted power.

4.2.6 Application Developed for Borewell Rescue Ranger Device

This device will be using Blynk IoT App to operate the device which includes engagement and disengagement of the working disk and lighting up the LED. Also, an IP address containing a web server which will show the live footage from the ESP32 Cam. The IP address will only be generated when the ESP32 Camera is connected to the desired SSID. The

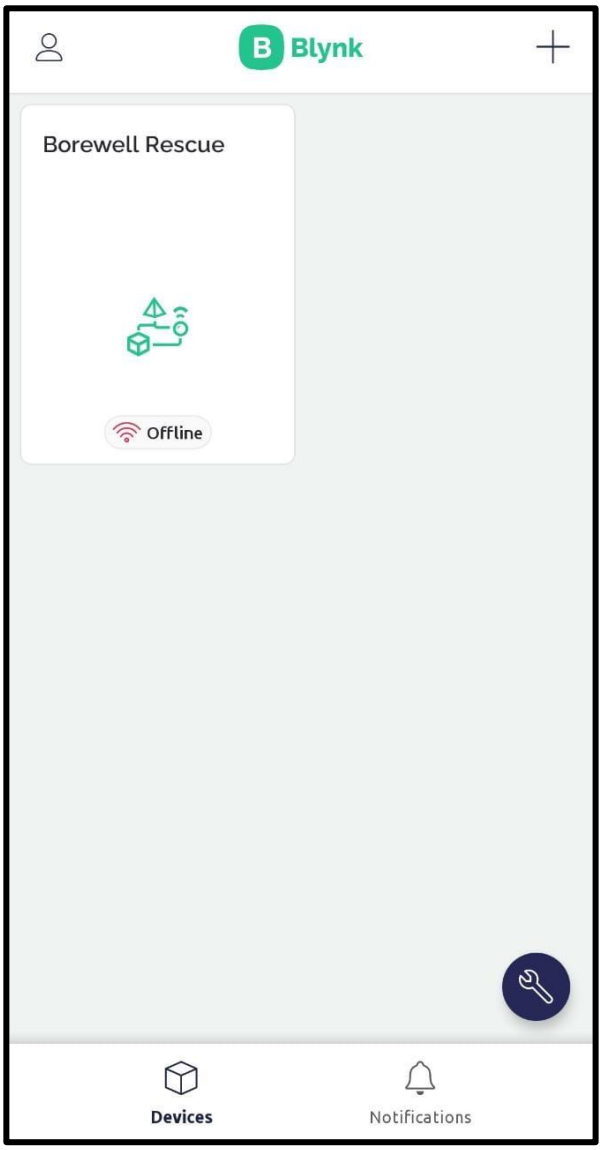

Figure 4.6 Blynk IoT Interface

reason behind choosing the Blynk IoT application is that it is an open source software and can be customized according to user requirements. The figure 4.6 shows the interface of the Blynk IoT application.

The Blynk IoT app uses C++ code language so it is easy to integrate it with our ESP8266 Wi-Fi Module Code. The template code generated from the app that is used in the ESP8266 Wi-Fi Module coding is as per below :-

```
#define BLYNK_TEMPLATE_ID "TMPL8fqSWSpO"
#define BLYNK_TEMPLATE_NAME "Home Automation and Meter"
#define BLYNK_AUTH_TOKEN "IJgKRYQnHNyWxHB90sExCUFnX-dBqhLh"
```

4.3 Calculations

The calculations for the borewell rescue ranger device is as below. Mild steel material is used for fabricating the main body that includes pipes and plates. The rivet pin that is used to connect the plate and the extended pipe is made of high speed steel material.

4.3.1 Design for the metal pipe

Force acted (w) = 300 N

$\sigma_{yt} = 360\ N/mm^2$ …….. From PSG. 1.9

$\sigma_{t=\frac{\sigma_{yt}}{Fos}}$ …….. Assuming FOS = 4

$\frac{360}{4} = 90\ N/mm^2$

$\sigma_t = \frac{load(w)}{area}$

$90 = \frac{300}{\frac{\pi}{4}(d^2)}$

$\therefore d = 2.06\ mm$

Selecting standard diameter = 12.7 mm or $^1/_2\ inch$

4.3.2 Design of rivet pin

P = 200 N

n=1

$\tau = 125\ N/mm^2$

$e(ecentricity = 70\ mm)$

$P * e = 300 * 70$

$P * e = 21000\ N/mm^2$

$c = \frac{21000}{70^2} = 4.28\ N/mm$

$F = 4.28 * 70 = 299.6\ N$

$R = \sqrt{(200^2) + (299.6^2) + 2(200) * (299.6) * \cos 0}$

$R = 499.6\ N$

$R = \frac{\pi}{4}d^2 * \tau$

$499.6 = \frac{\pi}{4}d^2 * 125$

$\therefore d = 2.25 \approx 4mm$

4.3.3 Design of metal plates

- As borewell have a standard size around 8–10-inch diameter selecting diameter of 6 inch.
- Taking thickness of plate(t) = 4 mm
- The material used for the plate is Mild Steel.

4.4 Construction and Fabrication of Borewell Rescue Ranger Device

According to the calculations done in section 4.3.1, 4.3.2 and 4.3.3 the total height and width of the device along with the diameter of the plates is been generated. The construction of the borewell rescue device is discussed as, there are 4 pipes of which 3 pipes are of 2.5 feet and 1 pipe which is extended further is of 3.5 feet, so the total height of the device becomes 3.5 feet. The pipes are attached to 3 plates having similar dimensions containing 4 holes for the pipes to go through and fit into it. While a separate plate of 5 inches is attached to the end of the extended pipe which is also known as the working plate of the device. The plate is attached to the pipe by using the rivet pin of 4 mm diameter. The material used to fabricate the pipes and plates is mild steel (MS). The images below show the process of fabrication :-

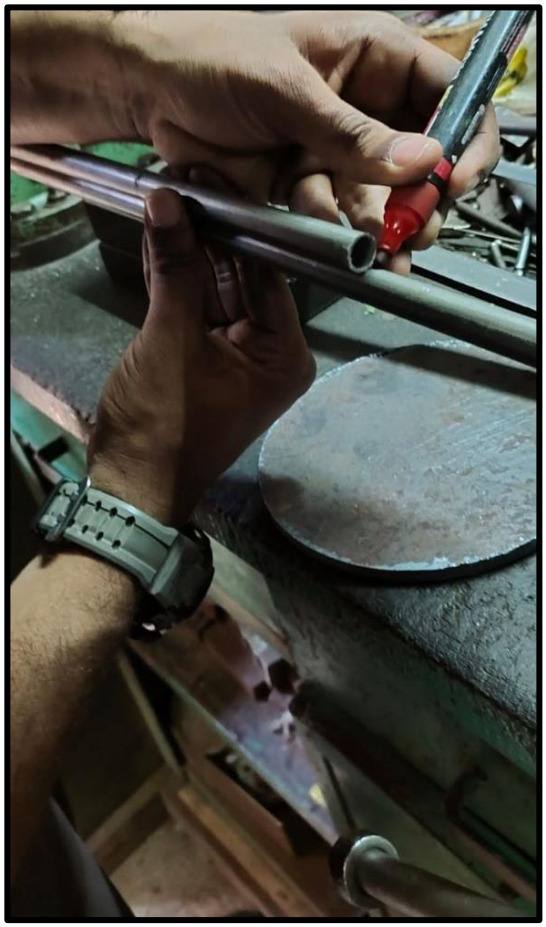

Figure 4.7 Fabrication of Pipes

Figure 4.8 Mild Steel Plates

Figure 4.9 Fabrication of Plates

Figure 4.10 Assembly of Borewell Rescue Ranger Device

Further discussing about the construction of the electronic circuit that is fitted onto the device is as follows, a 12 volts lead acid battery is used to supply power to the device, a 12v DC to DC buck current convertor is used which converts the 12 volt direct current from the battery to 5 volts for the ESP8266 Wi-Fi Module. A 2 channel relay is attached onto which the addressable LED strip and solenoid electromagnet is connected and further controlled by the ESP8266 Wi-Fi Module, and lastly a ESP32 Camera is situated at the bottom of the 3rd plate to moniter the conditions inside the borewell and behaviour of the child. The below images show the circuit assembly of the borewell rescue ranger device :

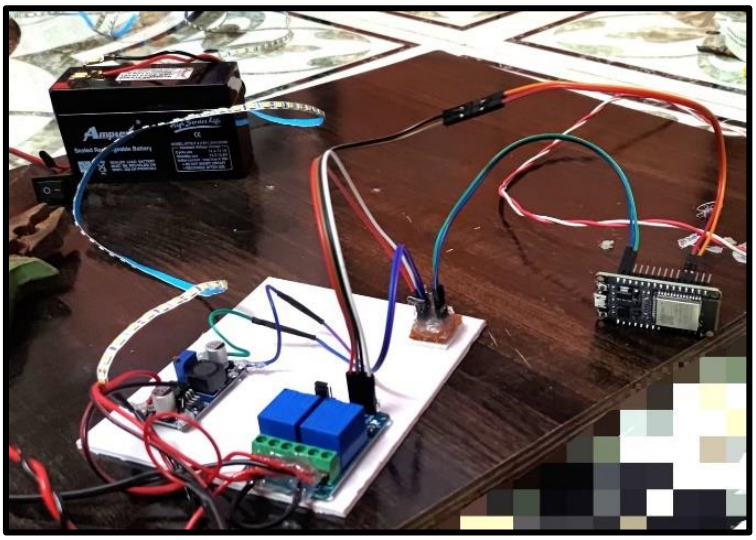

Figure 4.11 Electronic Components of Borewell Rescue Ranger Device

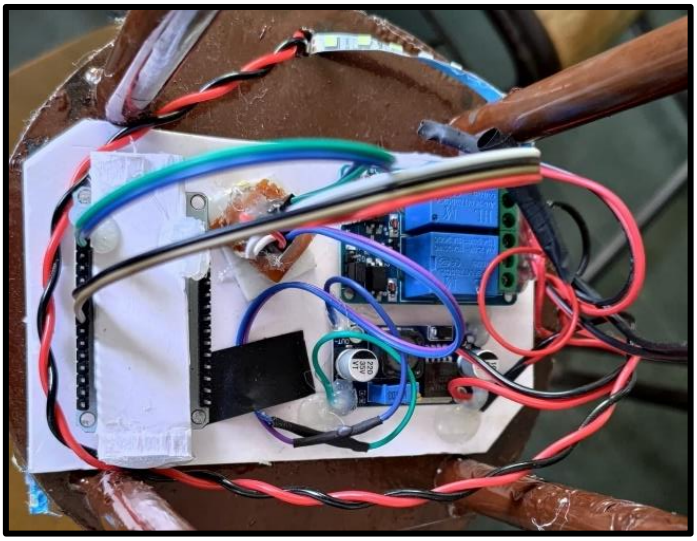

Figure 4.12 Circuit Assembly of the Electronic Components in Borewell Rescue Ranger Device

4.5 Programming of Borewell Rescue Ranger Device

The section 4.4 includes the program code that is used to control the device and monitor the conditions inside the borewell. ESP8266 Wi-Fi Module works as the brain of the device and the ESP32 Camera is used to monitor the conditions inside the borewell.

Section 4.4.1 includes the program code that is used in ESP8266 Wi-Fi module use to control the working plate which will be engaged at 90 degrees and disengaged at 180 degrees. Section 4.4.2 includes the program code that is used in ESP32 Camera Module that is used for monitoring the conditions inside the borewell and he activity of the child. The code is applied in such a way that when the ESP32 Camera module is connected to a wi-fi server it generates an IP address which needs to be opened into any browser that will show the live stream from camera to the browser.

The coding is done for the project using C++ language which is successfully executed by using the Arduino ide software. Figure 4.11 show the general software layout of the Arduino ide software.

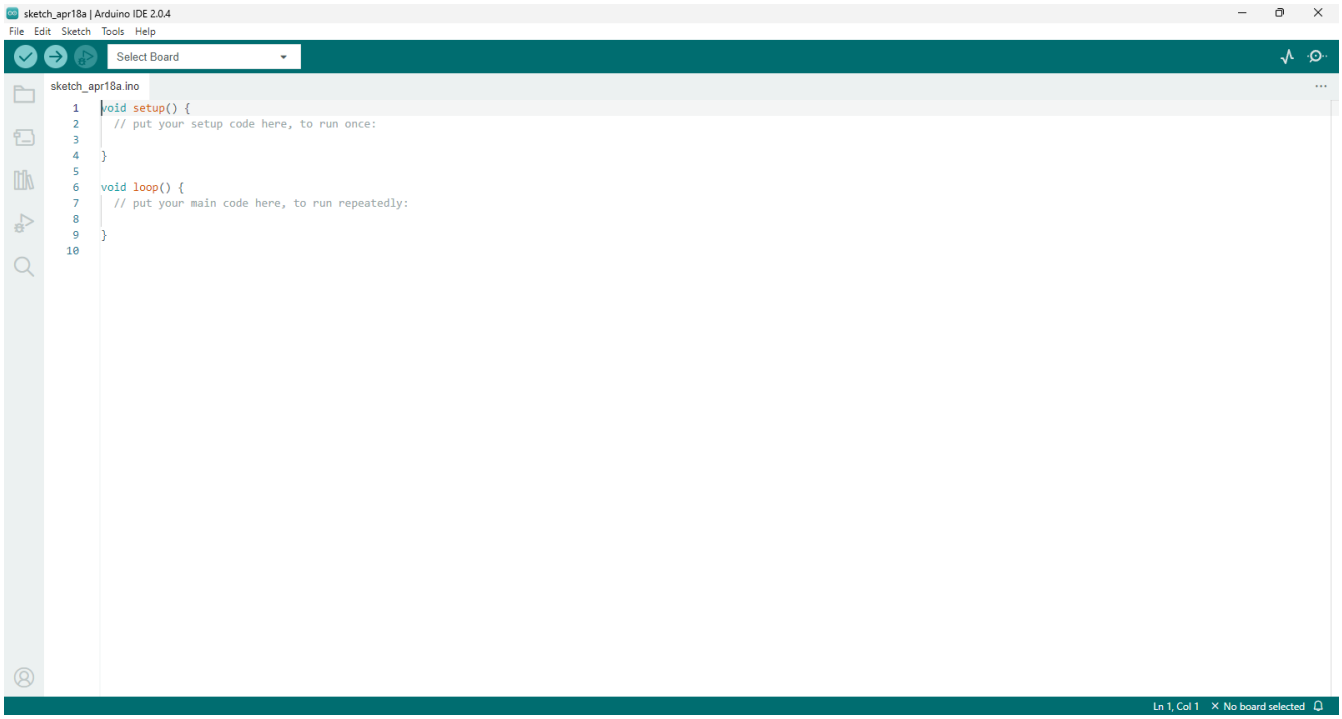

Figure 4.13 Arduino IDE Interface

4.5.1 Program Code Used for ESP8266 Wi-Fi Module for Working Plate

The code below is used to engage and disengage the working plate from 90 degrees to 180 degrees which sticked to the device pipe by a solenoid electromagnet and controlled by the Blynk IoT app. When the on and off button is triggered from the Blynk IoT app the plate is engaged and disengaged through solenoid electromagnet. An addressable LED strip is also connected below and around the 3rd plate and ESP32 Camera for extra brightness in the borewell, the LED strip is also controlled by the Blynk IoT app.

❖ **ESP8266 Wi-Fi Module Code (Using C++) :-**

```
#define BLYNK_TEMPLATE_ID "TMPL8fqSWSpO"
#define BLYNK_TEMPLATE_NAME "Home Automation and Meter"
#define BLYNK_AUTH_TOKEN "IJgKRYQnHNyWxHB90sExCUFnX-dBqhLh"

#include <Wire.h>
#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>


char ssid[] = "Silikon";
char pass[] = "12345678";

#define R1 26
#define R2 25
#define R3 32
#define R4 33
#define Current 34

void setup() {
  Serial.begin(115200);
  pinMode(R1, OUTPUT);
  pinMode(R2, OUTPUT);
  pinMode(R3, OUTPUT);
  pinMode(R4, OUTPUT);
  digitalWrite(R1, HIGH);
  digitalWrite(R2, HIGH);
  digitalWrite(R3, HIGH);
  digitalWrite(R4, HIGH);
```

```
  Blynk.begin(BLYNK_AUTH_TOKEN, ssid, pass);
}



void loop() {
  Blynk.run();
}

BLYNK_WRITE(V0) {
  int pinValue = param.asInt(); // Assigning incoming value from pin V3 to a
variable

  if (pinValue == 1) {
    digitalWrite(R1, LOW);
  }
  if (pinValue == 0)
  {
    digitalWrite(R1, HIGH);
  }
  //checkSwitch();
}
BLYNK_WRITE(V1) {
  int pinValue = param.asInt(); // Assigning incoming value from pin V3 to a
variable

  if (pinValue == 1) {
    digitalWrite(R2, LOW);
  }
  if (pinValue == 0)
  {
    digitalWrite(R2, HIGH);
  }
  //checkSwitch();
}
```

4.5.2 Program Code Used for ESP32 Camera for Condition Monitoring

The code below is used in ESP32 Cam which will be used for monitoring the conditions inside the borewell and he activity of the child. The code is applied in such a way that when the ESP32 Cam module is connected to a wi-fi server it generates an IP address which needs to be opened into any browser that will show the live stream from camera to the browser.

❖ **ESP32 Camera Code (Using C++) :-**

```
#include "esp_camera.h"
#include <WiFi.h>

//
// WARNING!!! PSRAM IC required for UXGA resolution and high JPEG quality
//            Ensure ESP32 Wrover Module or other board with PSRAM is selected
//            Partial images will be transmitted if image exceeds buffer size
//
//            You must select partition scheme from the board menu that has at
least 3MB APP space.
//             Face Recognition is DISABLED for ESP32 and ESP32-S2, because it
takes up from 15
//              seconds to process single frame. Face Detection is ENABLED if
PSRAM is enabled as well

// ===================
// Select camera model
// ===================
//#define CAMERA_MODEL_WROVER_KIT // Has PSRAM
//#define CAMERA_MODEL_ESP_EYE // Has PSRAM
//#define CAMERA_MODEL_ESP32S3_EYE // Has PSRAM
//#define CAMERA_MODEL_M5STACK_PSRAM // Has PSRAM
//#define CAMERA_MODEL_M5STACK_V2_PSRAM // M5Camera version B Has PSRAM
//#define CAMERA_MODEL_M5STACK_WIDE // Has PSRAM
//#define CAMERA_MODEL_M5STACK_ESP32CAM // No PSRAM
//#define CAMERA_MODEL_M5STACK_UNITCAM // No PSRAM
#define CAMERA_MODEL_AI_THINKER // Has PSRAM
//#define CAMERA_MODEL_TTGO_T_JOURNAL // No PSRAM
// ** Espressif Internal Boards **
//#define CAMERA_MODEL_ESP32_CAM_BOARD
//#define CAMERA_MODEL_ESP32S2_CAM_BOARD
//#define CAMERA_MODEL_ESP32S3_CAM_LCD
```

```
#include "camera_pins.h"

// ===========================
// Enter your WiFi credentials
// ===========================
const char* ssid = "brrdcam";
const char* password = "12345678";

void startCameraServer();
void setupLedFlash(int pin);

void setup() {
  Serial.begin(115200);
  Serial.setDebugOutput(true);
  Serial.println();

  camera_config_t config;
  config.ledc_channel = LEDC_CHANNEL_0;
  config.ledc_timer = LEDC_TIMER_0;
  config.pin_d0 = Y2_GPIO_NUM;
  config.pin_d1 = Y3_GPIO_NUM;
  config.pin_d2 = Y4_GPIO_NUM;
  config.pin_d3 = Y5_GPIO_NUM;
  config.pin_d4 = Y6_GPIO_NUM;
  config.pin_d5 = Y7_GPIO_NUM;
  config.pin_d6 = Y8_GPIO_NUM;
  config.pin_d7 = Y9_GPIO_NUM;
  config.pin_xclk = XCLK_GPIO_NUM;
  config.pin_pclk = PCLK_GPIO_NUM;
  config.pin_vsync = VSYNC_GPIO_NUM;
  config.pin_href = HREF_GPIO_NUM;
  config.pin_sscb_sda = SIOD_GPIO_NUM;
  config.pin_sscb_scl = SIOC_GPIO_NUM;
  config.pin_pwdn = PWDN_GPIO_NUM;
  config.pin_reset = RESET_GPIO_NUM;
  config.xclk_freq_hz = 20000000;
  config.frame_size = FRAMESIZE_UXGA;
  config.pixel_format = PIXFORMAT_JPEG; // for streaming
  //config.pixel_format = PIXFORMAT_RGB565; // for face detection/recognition
  config.grab_mode = CAMERA_GRAB_WHEN_EMPTY;
  config.fb_location = CAMERA_FB_IN_PSRAM;
  config.jpeg_quality = 12;
  config.fb_count = 1;

  // if PSRAM IC present, init with UXGA resolution and higher JPEG quality
  //                      for larger pre-allocated frame buffer.
  if(config.pixel_format == PIXFORMAT_JPEG){
```

```
    if(psramFound()){
      config.jpeg_quality = 10;
      config.fb_count = 2;
      config.grab_mode = CAMERA_GRAB_LATEST;
    } else {
      // Limit the frame size when PSRAM is not available
      config.frame_size = FRAMESIZE_SVGA;
      config.fb_location = CAMERA_FB_IN_DRAM;
    }
  } else {
    // Best option for face detection/recognition
    config.frame_size = FRAMESIZE_240X240;
#if CONFIG_IDF_TARGET_ESP32S3
    config.fb_count = 2;
#endif
  }

#if defined(CAMERA_MODEL_ESP_EYE)
  pinMode(13, INPUT_PULLUP);
  pinMode(14, INPUT_PULLUP);
#endif

  // camera init
  esp_err_t err = esp_camera_init(&config);
  if (err != ESP_OK) {
    Serial.printf("Camera init failed with error 0x%x", err);
    return;
  }

  sensor_t * s = esp_camera_sensor_get();
  // initial sensors are flipped vertically and colors are a bit saturated
  if (s->id.PID == OV3660_PID) {
    s->set_vflip(s, 1); // flip it back
    s->set_brightness(s, 1); // up the brightness just a bit
    s->set_saturation(s, -2); // lower the saturation
  }
  // drop down frame size for higher initial frame rate
  if(config.pixel_format == PIXFORMAT_JPEG){
    s->set_framesize(s, FRAMESIZE_QVGA);
  }

#if defined(CAMERA_MODEL_M5STACK_WIDE) ||
defined(CAMERA_MODEL_M5STACK_ESP32CAM)
  s->set_vflip(s, 1);
  s->set_hmirror(s, 1);
#endif

#if defined(CAMERA_MODEL_ESP32S3_EYE)
```

```
  s->set_vflip(s, 1);
#endif

// Setup LED FLash if LED pin is defined in camera_pins.h
#if defined(LED_GPIO_NUM)
  setupLedFlash(LED_GPIO_NUM);
#endif

  WiFi.begin(ssid, password);
  WiFi.setSleep(false);

  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");

  startCameraServer();

  Serial.print("Camera Ready! Use 'http://");
  Serial.print(WiFi.localIP());
  Serial.println("' to connect");
}

void loop() {
  // Do nothing. Everything is done in another task by the web server
  delay(10000);
}
```

Chapter Summary

This chapter describes the methodology, parts and specifications, calculations, and construction of a "Borewell Rescue Ranger Device," designed to rescue children who accidentally fall into borewells. The device is portable and easy to use, with an ESP8266 Wi-Fi module and a mechanical lifter playing key roles in its operation. The device is also equipped with an ESP32 camera to monitor the child's condition inside the borewell, and a 5V addressable LED strip to provide better lighting. The device uses a 12-volt DC battery and the Blynk IoT app for operation. The article includes calculations for pipe diameter, rivet pin, and plate thickness, and provides details on the construction of the device.

Chapter 5

Result and Discussion

This chapter includes explanation of working of the borewell rescue ranger device. Further the output images from the app that controls the device are included along with the camera footage outcomes.

5.1 Working of the Borewell Rescue Ranger Device

Working of the borewell rescue ranger device can be explained as, the whole device is connected to the Blynk IoT app through ESP8266 Wi-Fi Module by which the major process will be carried out in such a way that if a child is stuck inside the borewell the device will be sent into the borewell with the help of a rope attached to the hook provided above the device. The rescue ranger device is equipped with a ESP32 Camera which will help in studying the borewell and also observing the conditions inside the borewell and the behavior of the child. To get better vision inside the borewell we have attached a LED strip light alongside the camera controlled by the Blynk IoT app so there will be proper lighting inside the borewell.

The borewell rescue ranger device has an extended rod which will pass through a clearance area from the besides where the child is stuck and will bring the plate attached to the extended rod nearest to the feet of the child. The plate will be at 90 degrees when it goes inside

the borewell which is held by a solenoid electromagnet and controlled by Blynk IoT app. As soon as the plate reaches the feet of the child the current passing to the electromagnet will be turned off and the plate will fall from 90 degrees to an angle of 180 degrees and will be bought into contact with the feet of the child and then the child will be pulled up hence completing the rescue operation.

Figure 5.1 Borewell Rescue Ranger Device

5.2 Output from Blynk IoT Application

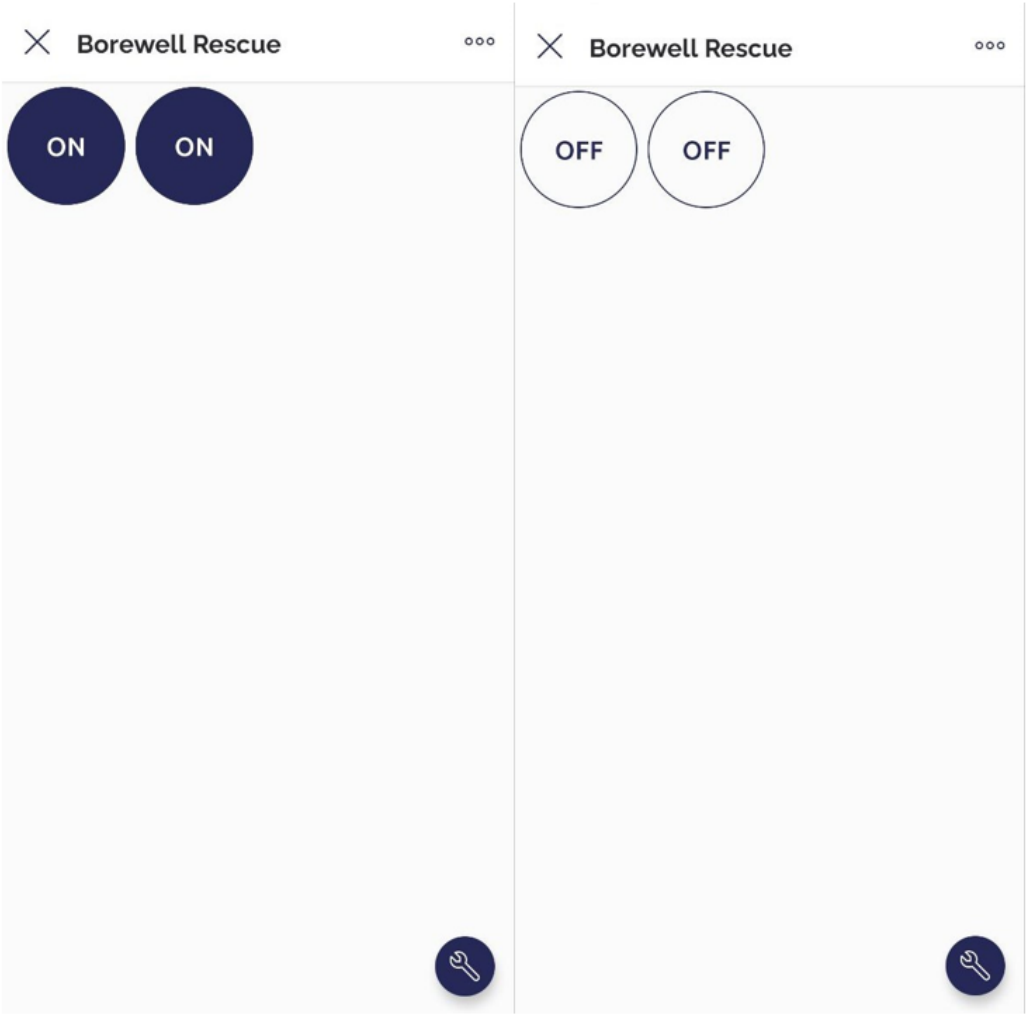

Figure 5.2 Output from Blynk IoT App

The figure 5.2 shows the in-app view of the Blynk IoT app which is used to control our device. The app majorly controls to components into our rescue ranger device that are the solenoid electromagnet and the LED strip. As you can see in the figure it shows the on and off status of the components.

5.3 Output from ESP32 Camera

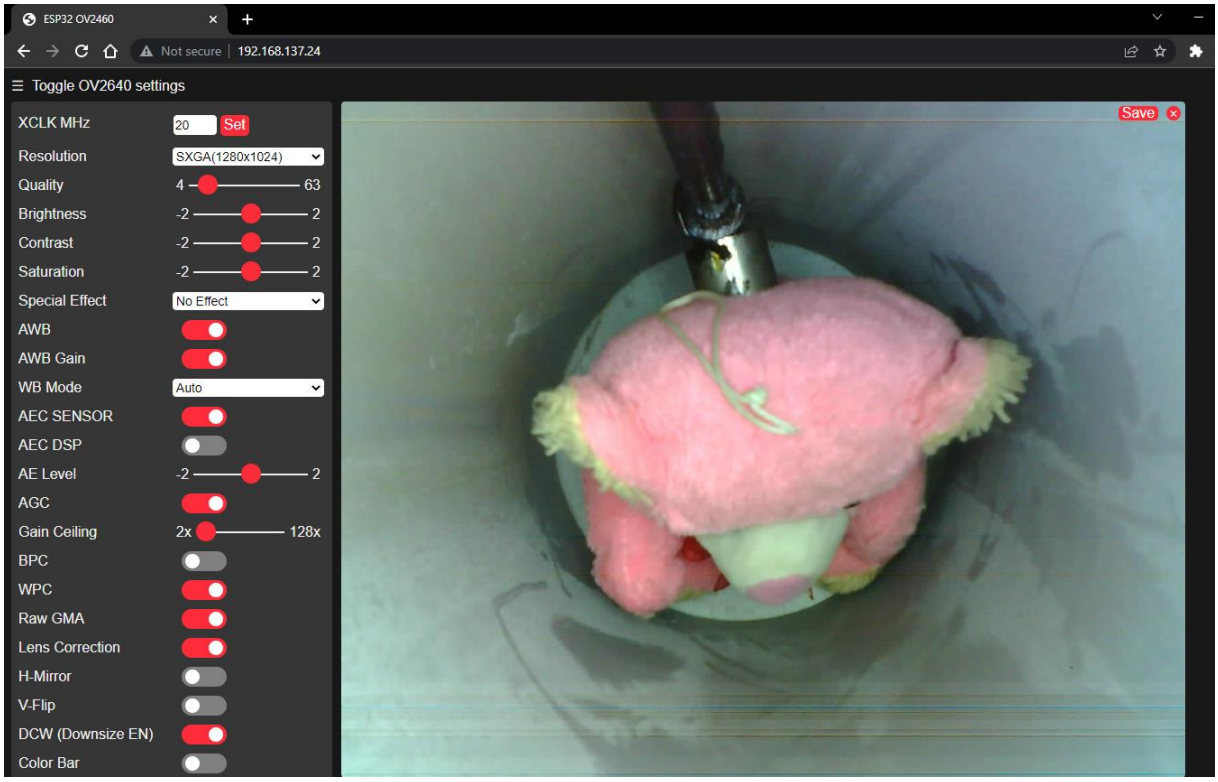

Figure 5.3 Output from ESP32 Camera

The figure 5.3 shows the of the dummy used as a child that is been rescued from the borewell. The live video footage from the camera can be seen when the ESP32 camera connects to a given network and then generates an IP address which is opened into the browser showing the live video footage of the child dummy been rescued from the borewell.

Chapter Summary

This chapter describes the borewell rescue ranger device, which is used to rescue a child stuck in a borewell. The device is connected to the Blynk IoT app through an ESP8266 Wi-Fi Module, and the process is controlled by the app. The device has an extended rod with a plate attached to it, which is held by a solenoid electromagnet and controlled by the app. The plate is brought into contact with the feet of the child, and the child is pulled up to complete the rescue operation. The device also has an ESP32 camera and LED strip light, which are controlled by

the app to provide proper lighting inside the borewell and study the conditions and behavior of the child. The chapter includes stress analysis of the working plate using ANSYS and output images from the app and camera footage outcomes. The Blynk IoT app controls the solenoid electromagnet and LED strip, and the live video footage from the camera can be seen when the ESP32 camera connects to a given network and generates an IP address that is opened into the browser.

Chapter 6

Conclusion and Future Scope

6.1 Conclusion

A robotic framework for rescue robotics in bore-well environment has been proposed here. Deeply observing those incidents and looking at the current circumstances it felt that the need to develop such framework for saving those innocent lives. In addition, there is a whole new research area waiting ahead us which deals with lots of challenges relating to mapping in unknown environment, real-time teleoperation in low lighting conditions, arm manipulation system. Rather than the technical development it would be highly satisfied if it can fulfil the most important aspect of the project, which is to save a life.

Coming to the conclusion of the project that the borewell rescue ranger device is successful in rescuing the child that is stuck inside the borewell as per the testing results.

6.2 Future Scope

The borewell rescue ranger device can also be used as a mechanical gripper in various industries like Oil and Gas or any automobile industry. The use of this device in these industries is that it will be used to lift heavy parts in automobile industries, it can be also used in oil extraction in oil and gas industries, it can be also used in mining purpose for extracting mineral.

Further there is an empty space provided on the device where an oxygen cylinder can be attached to provide oxygen to the child stuck inside the borewell as there is insufficient oxygen underneath the borewell as well as a communication device can be attached so that the family members would be able to make direct contact with the child a help him to be stable as possible for smooth rescue operation. A cloth catcher can also be added for extra grip for the rescue operation.

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