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# IoT based Water level Monitoring System

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***Abstract :*** The monitoring and management of the Neyveli hydro-geological basin is essential for the region's long-term lignite development. Due to water in the artesian aquifers beneath the lignite seam exerting an upward pressure, mining of lignite from the Neyveli lignite field has a hydrological difficulty, which is controlled by pumping at an optimal level. To overcome this issue, NLCIL uses a dipmeter to measure the water level in the borehole on a daily basis. This research looks at an IoT-based real-time water level monitoring system.To demonstrate this, sensors were installed on top of the containers to detect the water level and compare it to the depth of the container. AVR arduino microcontroller, LCD screen, Wi-Fi adaptor for data transmission, and buzzer are all used in the system. The LCD panel is utilised to show the status of the liquid levels in the containers exceeding their maximum capacity. The buzzer begins to ring, and the user's phone's alarm also begins to ring.

***Keywords****:* Ultrasonic Sensor, Arduino Uno, LCD display, Buzzer, 7.4V battery, Wireless network (Wi-Fi), Blynk App

## I. INTRODUCTION

Water is the most basic requirement for all forms of life on Earth, from microorganisms to living organisms. Water supplies are depleting all over the world and must be managed to ensure human survival. Water consumption has grown dramatically with India's growing population and increasing industrial and irrigation needs. With the advancement of mankind's living standards, the demand for potable water is increasing day by day. Groundwater is the main natural source of potable water. Groundwater can be used in a variety of ways by evaluating its capacity and quality, based on its availability [4]. For the past six decades, lignite has been mined at Neyveli by depressurizing the aquifer and pumping the groundwater for safe mining. Opencast mining is used by NLCIL to operate three lignite mines (Mine-I, Mine-IA, and Mine-II). The mining of lignite from the Neyveli lignite field is hydrologically difficult, as it is controlled by pumping at an optimal level because of water in the Artistic aquifers under the lignite seam exerting an upward pressure. The lignite is mined by NLC India Limited in the middle section of the Neyveli hydrological basin, which consists of semi-confined, upper confined, and lower confined aquifers (NLCIL) this aquifer is the most important source of drinking and irrigation water in the area. Water pumped from mines is legally used in NLCIL's industrial and township areas. For numerous reasons, indiscriminate drilling of bore wells for continuous discharge of ground water may generate problems in aquifer management. Water pollution is now at an all-time high. Almost every body of water is dangerously polluted. Water physio-chemical examination is critical, and all water sources must be identified before ingestion [7].NLCIL is pumping around 279560 litres of ground water per day from its mines for safe mining operations, all of which is used for Thermal Power Station demands. Neyveli Township's drinking water requirement of 44500 litres per day is met by treated storm water from Mine-II [4].We fail to recognise the environmental impact of our actions in our efforts to meet our demands and meet targets. In

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areas that are prone to pollution, we fail also to recognise the right and safe use of resources. We must adopt strategies that are less likely to affect the environment, particularly water bodies, both near and far away. A full assessment of the water bodies in the mining area should be conducted for this purpose in order to identify the problems that must be overcome [5].In recent years, our government has placed a greater emphasis on lignite mine safety, with the majority of lignite companies installing appropriate monitoring systems. However, due to the limited space, intricate tunnels, and harsh conditions, the existing lignite mine safe monitoring system cannot completely cover underground areas. Wired communications, intricate wiring, and high installation and maintenance expenses are the key difficulties. The firm's network structure is also tough to expand, and the monitoring position is readily moved into the blind zone. Wired communication mode has a strong dependence on the line, the circuit Would be corrupted and couldn't provide useful information effectively when accidents happened, So it is urgent to extend the monitoring range of underground areas to collecting various information relate to environmental sensor, Video, voice and other multimode information for enhancing the ability of mine safety monitoring[3].

## II. OBJECTIVE OF THE PROJECT

The main aim of the project is to develop an effective, effective real-time monitoring system so that water levels above the threshold can be determined and preventive measures implemented at the appropriate time, as the monitoring system may assist in the monitoring and control of the miningatmospheres.

- Designing a real-time monitoring equipment to continuously monitor the water level in the borehole is the primary goal of the project.
- Using an IoT-based water level monitoring system, construct a reliable and efficient communication system from the borehole to the surface.

## III. HYDROLOGICAL CHALLENGES

### *3.1 hydrogeological challenges in NLCIL mine*

In the neyveli basin, ground water pumping is required for lignite mining. The considerable hydrostatic pressure exerted at the base of the lignite seam by the underlying restricted aquifers indicated in "figure 3.3" made mining lignite a huge challenge. This was initially detected in November 1954, during the course of additional check drilling in the lignite field, Due to the lack of submersible pumps at the time, GSI performed a primitive bailer testing. This is acting at a base of lignite seams at a head of 75.9 m of water or a pressure of 7.6 kg/cm2. This demonstrated that any open cast excavation in a lignite deposit without managing the pressure of a constrained aquifer will cause the mine floor to burst. It should be noted that in order to maintain Hassle-free mining operations, NLC's mining activities required depressurizing of soil water. Pumping from large wells with a strategic location (drilling: 36 inches/casing: 20 inches) to in current locations, the limited aquifer pressure surface is controlled by the depths reported by hydrological testing. High submerged pumps with a head of 150 m, first of 175 HP and afterwards 250 HP, are now reduced to approximately one thousand gallons per minute per well and pumped to the optimum discharge[7].Characteristics of aquifers, their impact on groundwater quality, hydrogeochemical variations in water levels, piezometric surfaces, soil water budgets, and the effects of opencast lignite mining behaviour of major ions and trace elements in groundwater, possibility of seawater intrusion, and other environmental aspects in response to the hydro geological condition in the Neyveli Lignite Field Massive opencast mining and large-scale depressurization of the upper confined aquifer, as well as associated industrial activities such as pit head thermal power plants, urea plants, carbonization plants, and clay washing plants, have been disrupting the natural dynamics of the Neyveli for the past four and a half decades, and this, combined with increasing agricultural and domestic demand for groundwater year after

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year, may be affecting the natural dynamics of the Neyveli.

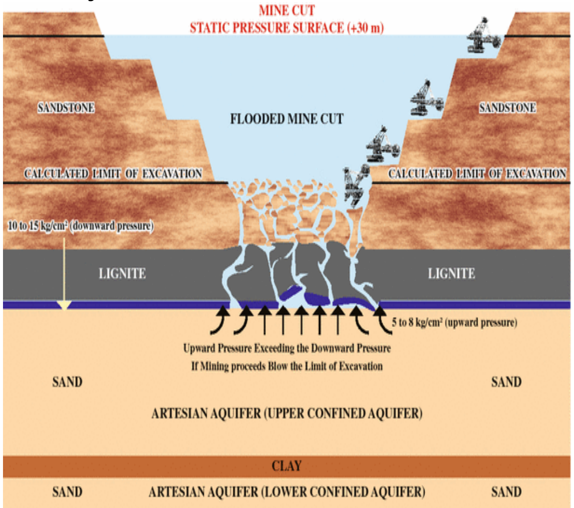


**Fig 3.1: shows the hydrogeological challenges in NLCIL mine**

• Below the lignite deposit, a massive reservoir with an upward pressure of 6 to 8 kg/cm$^2$ exists. The mining activity cannot be carried out safely unless the water pressure is decreased.
• In pumping wells, high efficiency pumps with capacities of 500 GPM and 1000 GPM are utilised to control ground water pressure.
• During the early stages, 50000 GPM of water was pumped out. However, it has now been decreased to 32000 GPM.
• For every tonne of lignite produced, around 13 tonnes of water must be drained away.
• A high overburden to lignite ratio (i.e., 11 ton: 1 ton)
• Ground water management also includes the treatment of seepage and storm water. Pontoons are used to control seepage water in areas where it exists.

### *3.2 GWC pumping in mine IA NLCIL:*

The Aquifer found in neyveli is in artesian condition so, to reduce the pressure bore well is drilled.
• Distance — A distance of 80-100 metres between two wells is ideal. Depending on the restricted Aquifer's pressure.
• Discharge - Each well pumps out 500 to 1000

GPM of water every minute. A well can therefore discharge 4541 litres of water every minute.

• Pumping time: Pumping takes place 24 hours a day, seven days a week, and 365 days a year.
• Draw down—Draw down is the difference between the non-pumping and pumping water levels. The average GWC pumping well drawdown is 8-10 metres.

Drilling can be divided into two types:
• GWC operation (reverse circulation drilling) - This method is used to drill big diameter (36”) boreholes.
• Small diameter (8”-24”) straight rotary drilling (Seepage operation) this form of drilling is most commonly employed for exploration. The cutting bits are carried in mud [4].

### *3.3 Types Of Bore Wells*

According to the purpose for which the bore wells are used, they are of two types:
1) Pumping Wells
2) Observation Wells

**1) Pumping Wells:**

The well that continuously pumps water from the aquifer. Pump discharges range from 500 to 1000 GPM, or 4541 liters per minute, as illustrated in the diagram (figure 3.2).


**Fig 3.2: shows the pumping well no 3309 used for depressurizing the aquifer**

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**2) Observation Wells:**

An observation well, or more specifically, a pump test, is a well that is used to record the observed change in groundwater level over time (figure 3.3). It's also referred to as a piezometer. Water level tape is used to determine the level of ground water in a well. The height of the ground level plus the water level can be used to compute the ground level from the MSL.


**Fig 3.3: shows the observation well no 34 used for measuring the level of ground water.**

## IV. METHODOLOGY

The Arduino UNO is a microcontroller development board based on the AT Mega 328, a sophisticated RISC (Reduced Instruction Set Computer) microcontroller with an 8-bit architecture.With a crystal frequency of 16MHz and a processing speed of 16MIPS, this is a real-time digital monitoring and control system (Million Instructions per Second).There are 16 digital input/output pins (six of which can be used as PWM outputs), six analogue inputs, four UARTs (Hardware Serial Ports), a USB programming interface, a power jack, an ICSP header, a reset button, and a few LEDs on the board. Everything you'll need to get started with the microcontroller is included. Connect it to your computer via USB or power it up using the provided adapter. It comes with everything you'll need to get started with the microcontroller. To get started, simply connect it to your computer via USB connection or power it with an AC to DC adaptor or battery.

Espress ion Systems, based in Shanghai, produces the ESP8266, a low-cost Wi-Fi microprocessor with full TCP/IP stack and microcontroller capability. The ESP-01 module, created by a third-party producer, Ai-Thinker, first brought the chip to the notice of western makers in August 2014. With this little module, microcontrollers can connect to a Wi-Fi network and make simple TCP/IP connections.

In the Internet of Things business, the ESP8266 presents a highly integrated Wi-Fi SoC solution to meet consumers' constant expectations for economic power utilisation, compact design, and consistent performance. The ESP8266 can function as a standalone application or as a slave to a host MCU due to its complete and self-contained Wi-Fi networking capabilities. When the ESP8266 is used to host the application, it starts up right away from the flash. The embedded high-speed cache aids in improving system performance and memory optimization. ESP8266 can also be used as a Wi-Fi adaptor in any microcontroller architecture using SPI / SDIO or I2C / UART interfaces. Antenna switches, RF baluns, power amplifiers, low noise receive amplifiers, filters, and power management modules are all included into the ESP8266EX. The small design reduces PCB size and necessitates fewer external circuits.

TCP/IP, the complete 802.11 b/g/n WLAN MAC protocol, and Wi-Fi Direct are all supported by the ESP8266EX. It not only enables basic service set (BSS) operations via the distributed control function (DCF), but also P2P group operations using the latest Wi-Fi P2P protocol. The ESP8266EX handles low-levelprotocol functionality automatically.

The BLYNK Google Play Application is used to access this information from anywhere in the world. BLYNK was created with the Internet of Things in mind (IoT). It can control devices remotely, show data, save data, visualise it, and do a variety of other tasks. BLYNK is a platform that allows you to control Arduino, Raspberry Pi, and other devices over the internet using an ios or Android app. It's a virtual dashboard where you may drag and drop widgets to

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construct a project's graphic interface. It takes less than five minutes to set up everything, and you'll be fiddling in no time. BLYNK isn't tied to any particular board or shield; instead, it works with whatever hardware you want. BLYNK will get you online and ready for the Internet of Things (IoT) whether your Arduino or Raspberry Pi is connected to the internet via Wi-Fi with ESP8266. In our project, BLYNK is used to monitor the water level in a lignite mine.

### *4.1 Surface Model*

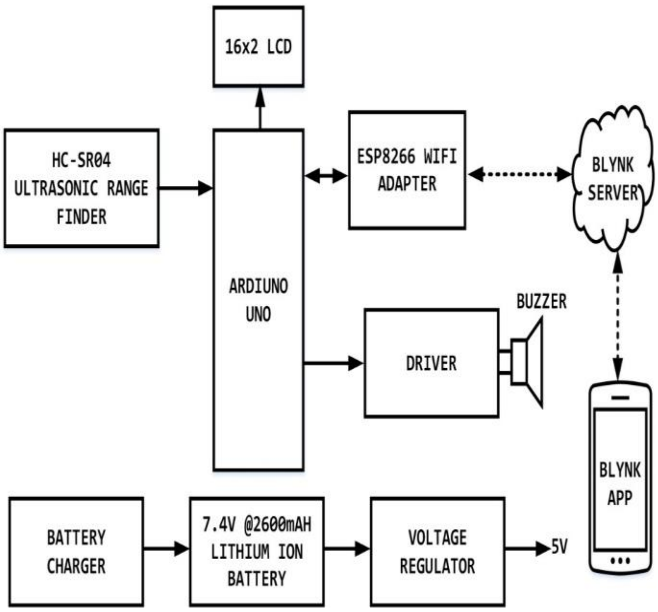


**Fig 4.1: Shows the Block Diagram of the Surface Model.**

The block diagram of the model is shown in Figure 4.1, where the sensor is used to monitor the water level's threshold limits. The water level is digitally measured using these sensors, which are connected to an Arduino Uno. To convert the digital signal to analogue form, a driver device was employed, and LEDs were used to inform the miners. The data is delivered to the surface receiver through an ESP8266 Wi-Fi transmitter linked to the microcontroller. This sets up wireless connection between the borehole model and the surface.

### 4.2 *Global Model*

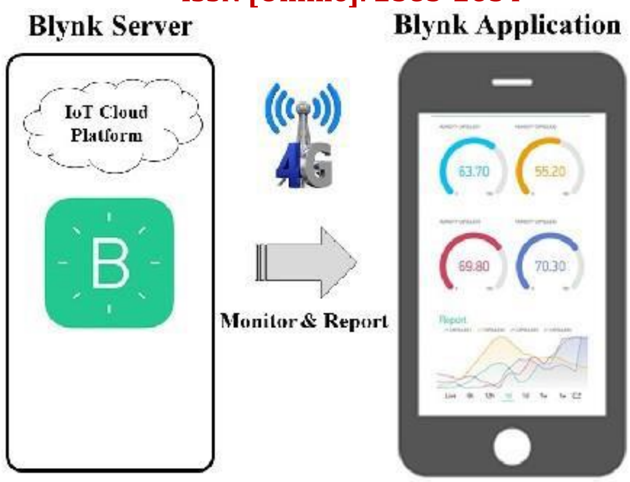


**Fig 4.2: Shows the Global Model**

The global model is depicted in Figure 4.2 above. The monitored data is saved in the cloud on the Blynk server. The Blynk programme can be used to access this information. This programme allows you to check the water level in real time from anywhere on the country.

### *4.3 Project Requirements*

- Arduino UNO – 8bit AVR Microcontroller based development board
- HC-SR04 Ultrasonic Range finder
- 16x2 Alpha numeric Liquid Crystal Display
- ESP8266 – Wi-Fi Transceiver
- 7.4V @2600mAH Lithium - Ion battery
- 5V Voltage Regulator
- BC547 - Driver
- Buzzer
- Battery charger
- PVC Housing
- Sketch IDE – Programming Arduino UNO
- BLYNK – Smartphone Google Play Store Application for IoT

The complete water level monitoring system was designed as shown in figure which consists of the all above components as well as additional components such as capacitors, drivers, operational amplifiers IC and voltage regulators.

## V. IMPLEMENTATION

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An artificial mining scenario is simulated inside the laboratory to evaluate the designed real-time monitoring system using wireless sensor network. The project will be executed in our college's underground mine model, and it will primarily focus on the surface and global modules. The surface variant includes an ultrasonic sensor, as well as a driver, an

ESP8266-wifi transceiver, and an Arduino Uno. The water in a borehole is monitored using an artificial laboratory mining environment. The pipe will be installed in a college underground mine model for a few metres before being inserted in a borehole. The pipe is filled with water when the threshold limit is exceeded. With the help of an LCD display, the water level % may be continuously checked. The buzzer begins to ring, and the user's phone's alarm also begins to ring. Blynk server/cloud and Blynk application are both part of the global model. The global approach allows data to be accessed at any time and from any location on the world.

### *5.1 Hardware Implementation*

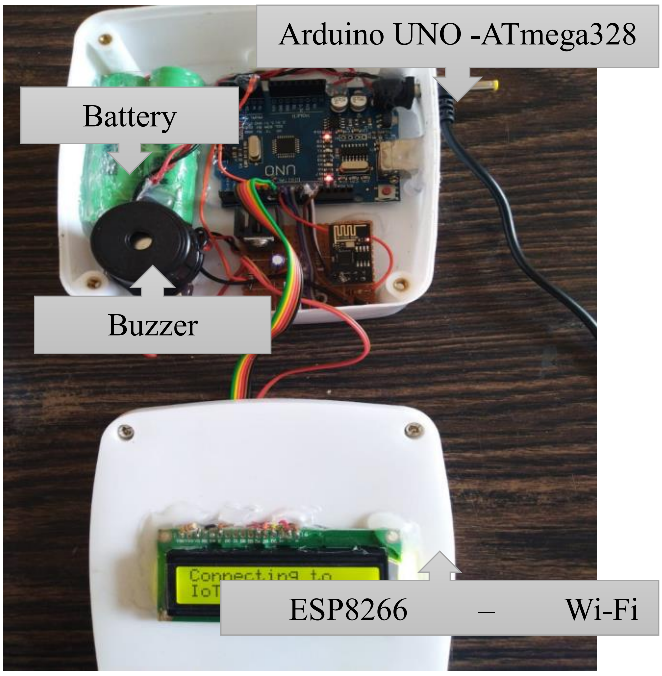
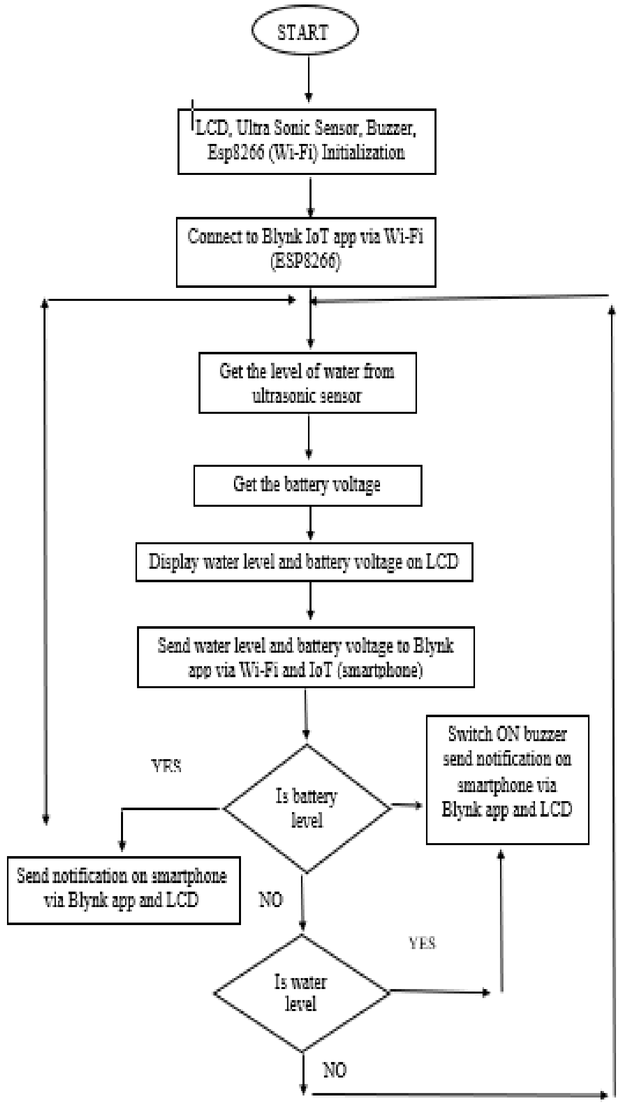



**Fig 5.1: show the water level monitoring device.**

## VI. ALGORITHM




## VII. RESULT

**Fig 7.1: Shows the Surface Model place in normal mine environment**

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**Fig7.2: model shows the Water level at 21 Inches and battery percentage**

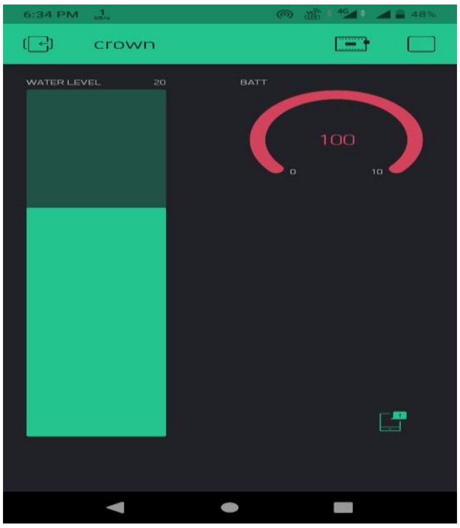

**Fig 7.3: Shows the real time Mine Data in the BLYNK app**

**Fig 7.4: model shows the Water level at 15 Inches**

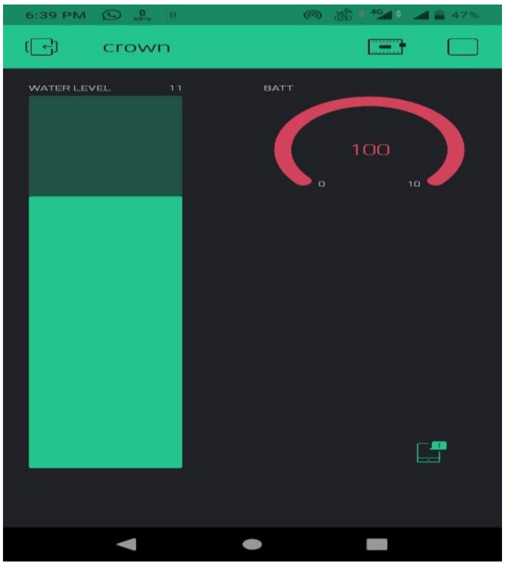

**Fig 7.5: Shows the real time Mine Data in the BLYNK app**

**Fig7.6: model shows the Water level at 11 Inches**

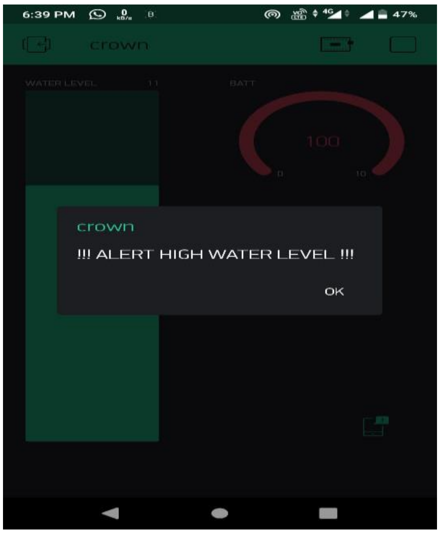

**Fig 7.7: Shows High Water level Alert notification in the BLYNK app**

The readings from the experiment are shown in the table below; the readings were taken

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between the hours of (1.50pm and 2.00pm), and the average reading was taken every 5 minutes during the time interval:

| S.No | Trail period | Level (inch) |
|---|---|---|
| 1 | 1.50 pm | 21 |
| 2 | 1.55 pm | 15 |
| 3 | 2.00 pm | 11 |

The idea was implemented in the underground mine model at the college. To create abnormal conditions, an artificial mining environment was created. As seen in the diagrams above, the real-time monitoring system functioned well: 7.1 to 7.7. When the Water level exceeded the allowed limits, which were specified by programming the Arduino ATMega328, an LED was activated.

The real-time water level monitoring system was successfully tested, and wireless connectivity between the borehole and the surface was established. The data was saved on the BLYNK server, which could be accessed in real time from anywhere.

## VIII. CONCLUSION

A continuous monitoring system is being developed to obtain nearly accurate measurements for the parameters in the borehole. The values are shown in real time on a surface-mounted LCD panel. The use of Wi-Fi proved successful in achieving this communication. When the alarm is activated, this wireless device can provide instant assistance in determining the state of the borehole's rising water level. When the water level reaches the Threshold limit / datum line, the beeping sound and buzzer begin to ring, signalling that it is time to pump the water from the pumping borehole.

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