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Smart Borewell Vehicle Monitoring System: A Microcontroller-based GSM Informer

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Abstract: ***This research paper presents an automatic borewell vehicle status informer designed using the Arduino MEGA 2560 microcontroller. The aim of this study is to enhance monitoring and communication in borewell operations, addressing the concerns of vehicle owners and customers. The system utilizes proximity sensors to calculate the number of borewell rods drilled and unloaded, while the location of the vehicle is tracked using GPS. Compressor runtime is recorded through an RTC or GPS module. Real-time SMS notifications are sent to the owner and customer when the compressor is switched on, providing location and time details. After completion of drilling, SMS messages containing the number of rods drilled and total compressor runtime are sent using a GSM module. All functionalities are controlled by the Arduino MEGA 2560 microcontroller, with measured parameters stored on an SD card. The proposed microcontroller-based informer integrates sensors and modules to improve efficiency and transparency in borewell operations. By providing accurate information and real-time communication, this system aims to enhance customer satisfaction and optimize the utilization of borewell resources.***

Keywords: Automatic borewell vehicle, Status informer Arduino MEGA 2560 microcontroller, Proximity sensors, GPS tracking, GSM module

I. INTRODUCTION

Efficient monitoring and management of borewell operations are essential for various industries, including agriculture, industry, and domestic water supply [2] [5]. However, traditional manual monitoring methods often lead to delays, inefficiencies, and increased costs. Additionally, the lack of real-time information and communication poses challenges for both borewell vehicle owners and customers [1]. This research paper focuses on addressing these challenges through the design and implementation of an automatic borewell vehicle status informer using the Arduino MEGA 2560 microcontroller. The primary objective of this study is to develop a comprehensive monitoring system that meets the needs of both vehicle owners and customers [4].

The proposed system utilizes proximity sensors to accurately calculate the number of borewell rods drilled into and unloaded from the ground [2]. It incorporates GPS tracking to monitor the location of the borewell vehicle [5]. The runtime of the compressor, a critical component in borewell operations, is recorded using either a Real-Time Clock (RTC) or the GPS module [3]. A key feature of the system is the integration of a GSM module, enabling real-time communication. When the compressor is switched on, an SMS notification is sent to both the borewell owner and the customer, providing them with the location and time details [4]. Upon completion of the drilling process, another SMS is sent, conveying the number of rods drilled and the total compressor runtime [2].

The Arduino MEGA 2560 microcontroller serves as the central processing unit, responsible for data acquisition, processing, and communication [5]. The measured parameters are stored in the memory of an SD card for future analysis and reference. It presents an innovative approach to enhance borewell operations by developing an automatic borewell vehicle status informer [6]. By integrating various sensors, modules, and real-time communication, the system aims to improve monitoring, transparency, and customer satisfaction [1]. The subsequent sections of this paper delve into the detailed system design, implementation, and experimental results, providing valuable insights into the practicality and effectiveness of the proposed solution.

II. LITERATURE SURVEY BASED ON DIFFERENT TECHNOLOGIES

Manual Monitoring: In the past, borewell vehicle status was manually monitored, requiring individuals to physically observe and record the drilling process, rod count, and compressor runtime. This method is time-consuming, prone to errors, and lacks real-time updates [7].

Sensor-Based Monitoring: Some earlier technologies utilized sensors to monitor borewell vehicle parameters. For example, proximity sensors were employed to count the number of borewell rods drilled into the ground and unloaded from the ground. However, these systems often lacked remote monitoring and communication capabilities [8].

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GSM-Based Monitoring: GSM (Global System for Mobile Communications) technology has been widely adopted for remote monitoring and control applications. Previous systems have utilized GSM modules to send SMS alerts to borewell owners and customers when the compressor is switched on, along with its location and time. This approach provides real-time updates and improves communication efficiency [9].

Microcontroller Integration: Microcontrollers, such as Arduino and ARM, have been used to interface with sensors, GSM modules, and other components in the borewell vehicle status informer system. These microcontrollers provide processing power, data management capabilities, and connectivity options to monitor and control various parameters effectively [10].

GPS-Based Location Tracking: GPS (Global Positioning System) modules have been integrated into borewell vehicle status informer systems to track the location of the vehicle accurately. By incorporating GPS technology, the system can provide precise location information along with other monitored parameters [11].

Data Storage and Analysis: Previous technologies have implemented memory storage options, such as SD cards, to store the measured parameters for later analysis. This allows for historical data tracking, performance evaluation, and troubleshooting [12].

Previous technologies for borewell vehicle monitoring and control have faced certain limitations. Manual monitoring methods are time-consuming, prone to errors, and lack real-time updates. Sensor-based systems, although useful for measuring certain parameters, often lack remote monitoring and communication capabilities. Additionally, previous technologies may rely on specific communication networks or lack comprehensive data storage and analysis capabilities. To overcome these limitations, we propose a "Microcontroller Based Borewell Vehicle Status Informer Using GSM." This system integrates microcontroller technology, such as Arduino or ARM, with GSM modules to provide real-time updates, remote monitoring, and efficient communication. By incorporating GPS-based location tracking and data storage options, this solution offers accurate vehicle tracking, historical data analysis, and improved monitoring efficiency. The proposed system aims to address the limitations of previous technologies and enhance the overall effectiveness and reliability of borewell vehicle monitoring and control.

III. IMPLEMENTATION OF THE PROPOSED SYSTEM

The implementation of the proposed "Microcontroller Based Borewell Vehicle Status Informer Using GSM" system represents a significant advancement in the field of borewell vehicle monitoring and control. By harnessing the capabilities of microcontrollers, specifically the Arduino MEGA 2560, this system offers an automated and efficient approach to track and manage critical parameters. It addresses the shortcomings of manual monitoring methods and earlier technologies by providing automation, remote monitoring capabilities, and real-time updates. Through the integration of proximity sensors, GPS modules, GSM technology, and real-time clock functionality, the system provides accurate and timely information regarding the borewell drilling process, rod count, compressor runtime, and vehicle location. Borewell owners and customers benefit from instant SMS notifications, delivering comprehensive updates on the status and whereabouts of the borewell vehicle.

Additionally, the incorporation of SD card-based data storage facilitates later analysis, historical tracking, and performance evaluation. Ultimately, the implementation of this system aims to optimize the satisfaction of borewell vehicle owners and customers by offering precise, real-time information and streamlining the monitoring and control process. The below Fig.1 shows block diagram of the proposed system.

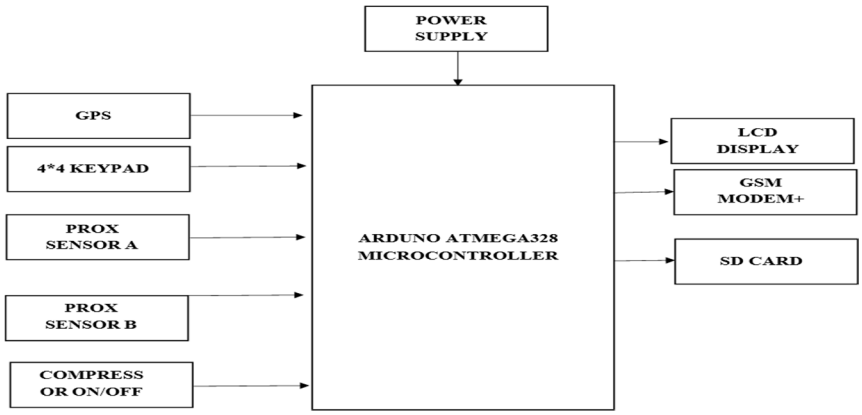


Fig.1 Block diagram of Smart Borewell Vehicle Monitoring System: A Microcontroller-Based GSM Informer

A. An Overview Of All The Blocks

1) Power Supply: The power supply block ensures the availability of stable and reliable power to all the components in the system. It is crucial for the continuous operation and functionality of the system.
2) GPS (Global Positioning System): The GPS module provides accurate location tracking of the borewell vehicle. It enables real-time monitoring and ensures that the vehicle's location is recorded and communicated effectively.
3) 4x4 Keypad: The 4x4 keypad serves as an input interface for users to interact with the system. It allows for easy and convenient input of commands, settings, and information, enhancing user control and accessibility.
4) Proximity Sensor A: This sensor is used to detect the presence or absence of borewell rods during the drilling process. It enables accurate counting of the number of rods drilled into the ground and unloaded from the ground.
5) Proximity Sensor B: Similar to Proximity Sensor A, this sensor is used to detect the presence or absence of borewell rods. It aids in tracking the drilling process and ensures the accurate measurement of the number of rods drilled.
6) Compressor On/Off: The Compressor On/Off block controls the operation of the compressor used in the borewell vehicle. It allows for easy activation and deactivation of the compressor based on the drilling requirements.
7) ATmega328 Microcontroller: The ATmega328 microcontroller acts as the central processing unit of the system. It coordinates the communication between various components, processes the data, and controls the overall functionality of the system.
8) LCD Display: The LCD display provides visual feedback by presenting relevant information, such as the status of the drilling process, rod count, compressor runtime, and system messages. It enhances user interaction and enables quick and easy monitoring of the system's parameters.
9) SD Card: The SD card serves as a storage medium for recording and storing the measured parameters, including rod count and compressor runtime. It allows for data retention, historical tracking, and later analysis of the borewell operations.
10) GSM Modem: The GSM modem facilitates communication between the system and the borewell owner or customer. It enables the system to send SMS alerts containing vital information, such as compressor activation, location updates, and drilling statistics, providing real-time notifications and ensuring effective communication.

Each component plays a crucial role in the proposed system, contributing to its overall functionality, data accuracy, monitoring capabilities, and communication efficiency. Their integration and seamless operation allow for automated and reliable borewell vehicle status monitoring using GSM technology.

B. Working Of The Proposed System

To initiate the system, the power supply block is switched on. This activates the entire system, with the microcontroller, such as Arduino, taking control. The system prompts the user to enter their phone number using the 4x4 keypad. The user enters the phone number, and the microcontroller stores it in the data storage unit for future reference. Simultaneously, the GPS module is activated to acquire the current location of the borewell vehicle. The latitude and longitude data are retrieved to determine the precise location. Throughout the drilling process, the proximity sensors, Proximity Sensor A and Sensor B, continuously monitor the presence or absence of borewell rods. The microcontroller interprets the sensor input and counts the number of rods drilled into and unloaded from the ground. By combining the counts from both sensors, the system accurately determines the total number of rods drilled.

The system also incorporates compressor control to monitor the status of the compressor. The microcontroller receives input from the Compressor On/off block, enabling it to determine whether the compressor is switched on or off. If the compressor is switched on, the system records the start time and sends an SMS notification to the phone number entered by the user. The SMS includes the location information obtained from the GPS module, as well as the start time of the drilling process. Throughout the drilling process, the microcontroller continuously monitors the status of the proximity sensors and updates the rod count in real-time. This ensures accurate tracking of the drilling progress.

Once the drilling process is complete, the system calculates the total runtime of the compressor by subtracting the start time from the current time.

The compressor runtime is converted to seconds for precise measurement. All the relevant information, including the final rod count, compressor runtime, and location details, is stored in the data storage unit for future analysis and reference.

Finally, the microcontroller sends an SMS notification to the user's entered phone number. The SMS contains the location details, the total number of rods drilled, and the compressor runtime in seconds. This comprehensive summary provides the user with real-time updates on the borewell operation, allowing for better monitoring and management.

IV. RESULTS AND DISCUSSIONS

In this section we are discussing about results generated by the proposed Smart Borewell Vehicle Monitoring System: A Microcontroller-Based GSM Informer. Below Fig.2 shows that kit diagram of Smart Borewell Vehicle Monitoring System: A Microcontroller-Based GSM Informer. User will get SMS regarding location, No.of Roads, compressor time in seconds. Both the owner and costumer will get the SMS and location access. Fig.3 and Fig.4 shows that SMS from the owner and customer mobiles. Fig.5 and Fig.6 shows that location access sent t the owner and customer mobiles

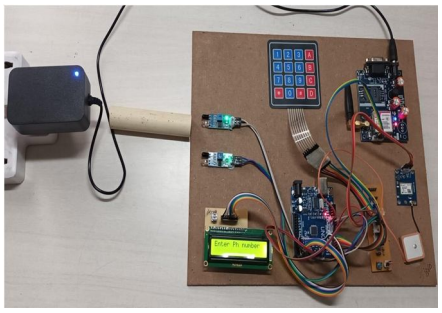


Fig.2 kit diagram of Smart Borewell Vehicle Monitoring System: A Microcontroller-Based GSM Informer

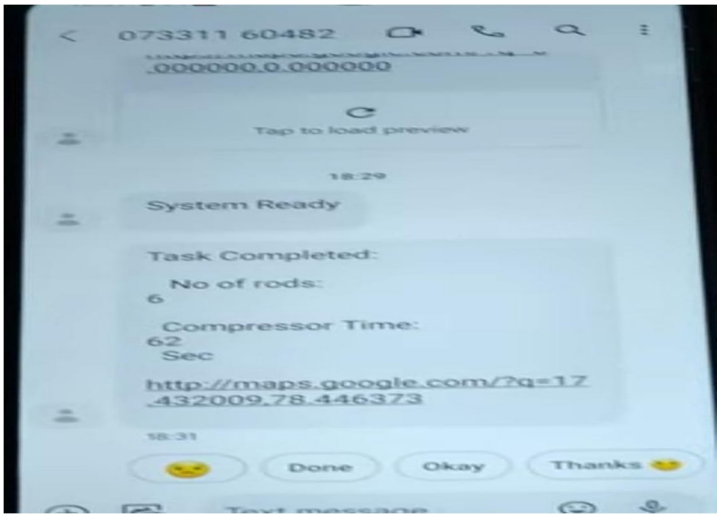


Fig.3 Messages received by the registered number of the owner

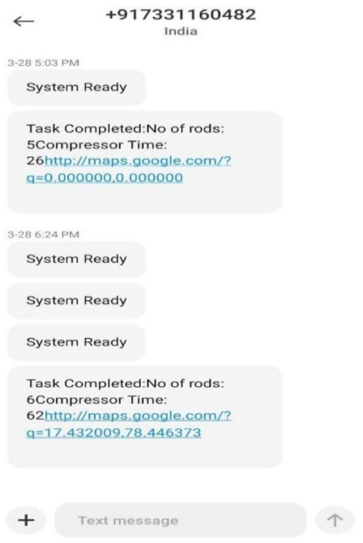


Fig.4 Messages received by the registered number of the owner

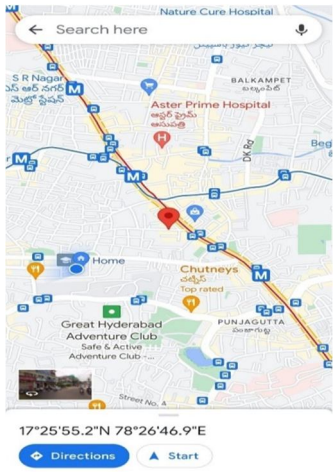


Fig.5 Location of the borewell vehicle in the owner's phone

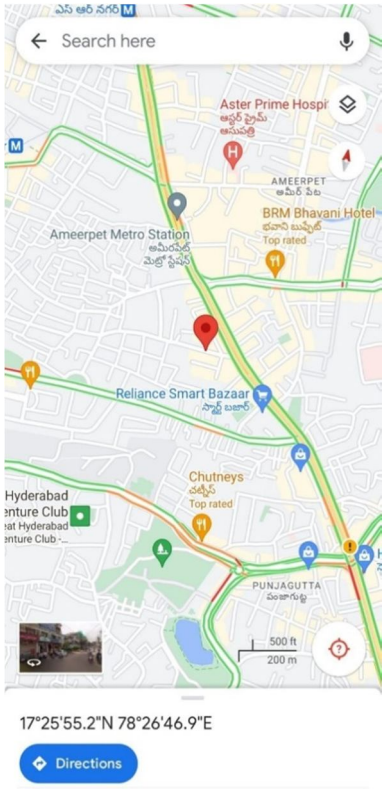


Fig.6 Location of the borewell vehicle in the customer's phone

V. CONCLUSION

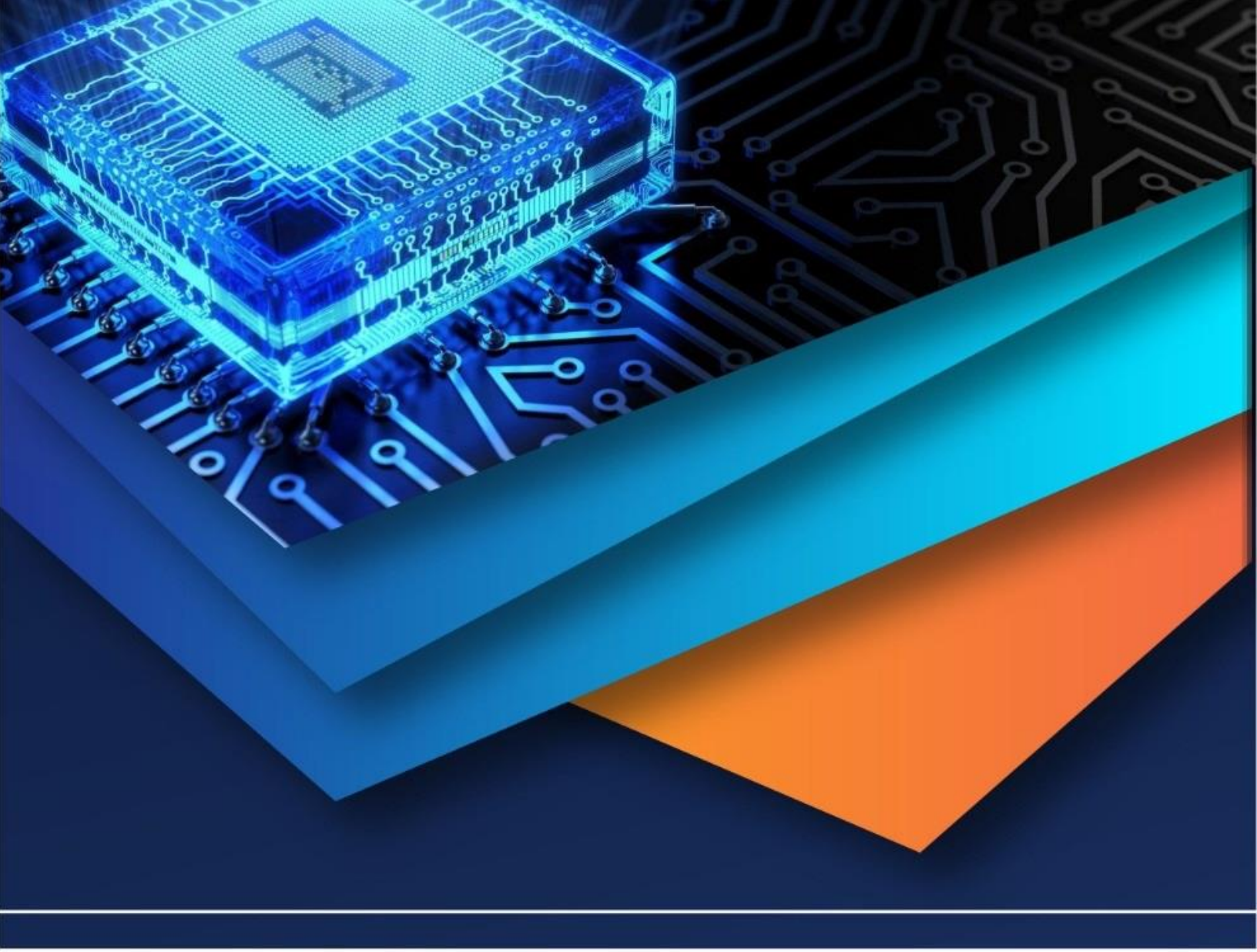
The proposed " Smart Borewell Vehicle Monitoring System: A Microcontroller-Based GSM Informer " project integrates a 4x4 keypad for user number entry, data storage for storing information, and a GSM module for SMS notifications. The system combines proximity sensors, GPS technology, and a microcontroller to monitor the drilling process, count the number of rods drilled, record the compressor runtime, and send SMS notifications. The user enters their phone number using the 4x4 keypad, which is stored in the data storage unit. The system sends an SMS to the user's entered phone number, including the location, the total number of rods drilled, and the compressor runtime in seconds. This enhanced system provides accurate monitoring, data storage, and efficient communication, enhancing the overall borewell operation.

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