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# Operation and Control of Power System Using Artificial Intelligence

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**ABSTRACT:** The primary objectives of our project are to prevent theft at power lines, provide a warning when the oil level in the transformer reaches a critical level, detect voltage fluctuations in the power lines, indicate blown fuses at substations to the KEB station, implement load shedding based on lineman's schedule, and detect faults in the power lines. The control systems for the power lines will be located at a distant location from the substations and will communicate wirelessly. Information from the substations will be displayed on an LCD screen provided on the panel. In the proposed artificial intelligence system for electrical power lines, we will utilize technology to detect voltage fluctuations, power line faults, transformer oil levels, and implement load shedding. These detected conditions will be relayed to the transformer. Arduino, a versatile microcontroller, will be used to facilitate these tasks. The control systems will be located remotely, communicating wirelessly with the substations. This project will utilize Arduino microcontrollers to facilitate the necessary functionalities. All these measures are essential due to the current challenges faced in power generation and the maintenance of power stations and substations, particularly in remote areas.

## I. INTRODUCTION

Our project focuses on preventing power line theft, indicating transformer oil levels, detecting voltage fluctuations, signaling blown fuses, implementing load shedding, and identifying power line faults. The control systems will be remotely located, communicating wirelessly with substations. Substation data will be shown on an LCD screen. Our AI system for power lines will detect voltage changes, power line faults, transformer oil levels, and manage load shedding. These conditions will be transmitted to transformers using relays. We'll employ Arduino, a microcontroller, to achieve these tasks. The current power generation scenario faces challenges like low rainfall and fuel shortages. Thus, maintaining power and KEB stations becomes vital. Load shedding becomes necessary in high-consumption areas, and power theft must be curbed. KEB stations are often distant, needing remote monitoring. Transformer oil levels must be maintained to prevent damage. Voltage fluctuations can cause fuse blows, disrupting power. These issues are crucial for KEB stations, motivating our proposed solution. To sum up, our project addresses power theft, transformer oil levels, voltage fluctuations, blown fuses, load shedding, and power line faults. Controls will be remote, linked wirelessly to substations. Arduino microcontrollers will enable these functions. These measures are crucial due to power generation challenges and remote station maintenance.

## II. OBJECTIVE

We're currently encountering power generation challenges due to limited rainfall and fuel supply. This has made maintaining power and KEB stations crucial. To address power shortage, we need load shedding in high-consumption areas and strong measures against power theft. In rural regions, KEB stations are far from villages with transformers, which require proper oil upkeep. Fluctuations in power lines can cause fuse blowouts at substations. Our project aims to prevent theft, monitor transformer oil, detect voltage shifts, signal blown fuses, and identify faults using GSM technology. Our aim is to enhance power system efficiency, especially in rural areas where power is vital for development.

### 2.1 Block Diagram Description

In this project, there are two sections we have used, substation and base station. The power substation will be located in a field within the village, where the power lines are utilized for transmission of electricity. And Base station will be placed at the KEB station where all the controls of power lines will be located usually these Base stations will be far away from the Substation and they communicate each other wirelessly using GSM. And the information from the Substation will be displayed on LCD provided at the Base station.

At the base station we are going to detect the voltage fluctuation, Single phase detection, Fault in power line, oil level at the transformers and power theft which will be in power lines. Fuse blown detector also added in this Substation. These all-detected conditions transmitted to the Base station through GSM, which we have shown.

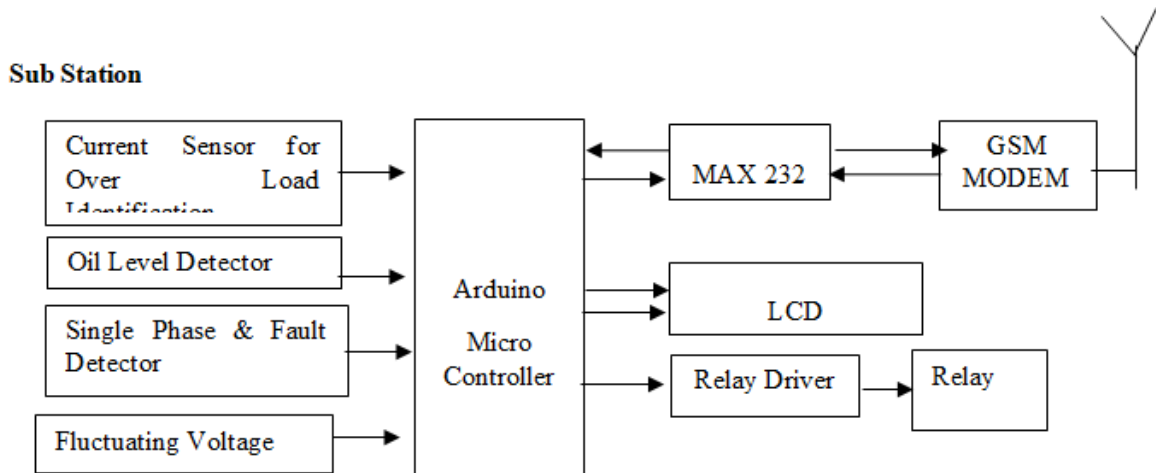


Figure 2.1(a): Sub station

**Base station**

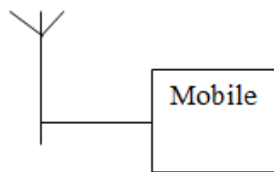


Figure 2.2(b): Base station

**III. SYSTEM DESCRIPTION**

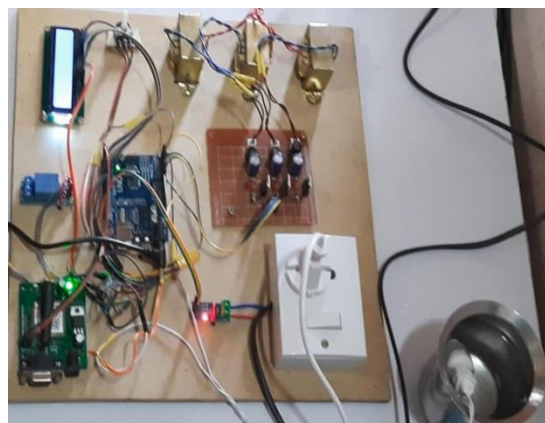


Figure 3: model of Operation and Control of Power System Using Artificial Intelligence

**ARDUINO UNO:** Front and Back views of Arduino Uno R3, front view of Arduino Uno R2, front view of Arduino Uno SMD, front and back views of Arduino Uno, demonstration. Arduino Uno is microcontroller. Board is based at ATmega328 (datasheet). This device has 14 digital input/output pins, 6 analog inputs, and a 16MHz ceramic resonator, a USB connector, an electricity connector, ICSP connector, and reset button. It has the entirety to help the microcontroller. Simply connect to your pc with the USB cable, or electricity it with the AC-DC adapter or batteries,

and you are equipped to go. Microcontroller (MCU):IC: Microchip ATmega328P,Flash Memory: 32 KB,SRAM: 2 KB,EEPROM: 1 KB,Number of USART peripherals: 1 (By default, the Arduino software configures USART as an 8N1 UART),I2C peripherals: 1,SPI peripherals: 1,Operating Voltage: 5 Volts,Digital I/O Pins: 14,PWM Pins: 6 ,DC Analogue Input Pins: 6,DC Flow for 3.3V Pin: 50 mA,Size: 68.6 mm x 53.4 mm,Weight: 25 g,ICSP Header: Yes

**GSM MODEM:** A GSM modem, also called GSM module or cellular modem, facilitates communication between a computer or microcontroller and a GSM network. It allows devices to transmit and receive data over a GSM network using standard AT commands.GSM is a widely adopted digital cellular network standard used by mobile devices. GSM modems work as a means of connecting devices to this network for various purposes, including sending SMS messages and receiving SMS messages, making voice calls, and accessing data services.

**LIQUID CRYSTAL DISPLAY (LCD):** Liquid crystal displays (LCDs) are low-priced and power-green devices able to show textual content and snapshots. They may be generally utilized in embedded systems wherein video display units aren't normally to be had, unlike computer systems. LCDs may be found in various ordinary devices, including watches, fax machines, reproduction machines, and calculators. An LCD is an optical device that uses electronic modulation. It is miles are designed as a skinny and flat panel along with numerous clarify if you prefer a display with color or monochrome pixels of liquid crystals. Those pixels are arranged in front of a mild source (backlight) or reflector.

**ADAPTER:** The 12V 2A adapter is A power supply unit responsible for converting the energy source input power from an electrical outlet into a 12-volt output voltage and 2-ampere current. It is specifically designed to provide power to devices or charge batteries that require a 12V, 2A power supply. The adapter is equipped with a standard connector or plug, allowing it to be easily connected to the device or battery in need of power.

**POWER SUPPLY:** Power supply is an essential component in electronic systems as it provides the necessary power for their proper operation. Various components like the microcontroller, audio amplifier, keyboard, and edge connector require a regulated +5V output voltage,

**VOLTAGE REGULATOR:** The LM7805 is a widely-used integrated circuit (IC) voltage regulator that delivers a steady and regulated output voltage of +5 volts (DC) from an unregulated input voltage source. It finds frequent application in electronic circuits, where it supplies a reliable 5-volt power to low-power digital or analogue components that necessitate a stable voltage source.

**ACS712 CURRENT SENSOR:** The ACS712 is an electrical module for current sensing that utilizes the Hall Effect principle, enabling the measurement of current flow in a circuit without need for invasive methods. It finds widespread usage in applications that necessitate the monitoring or control of current levels.

**VOLTAGE SENSOR:** A voltage sensor is a electronic device utilized for the measurement and detection of voltage levels within an electrical circuit. Its primary applications include voltage monitoring, voltage protection, and the activation of specific actions based on predefined voltage thresholds.

**RELAY DRIVER:** The Relay Driver Circuit is essential component of Fire Detection system, responsible for transmitting a signal in response to sudden temperature fluctuations. These temperature changes typically indicate the occurrence of a fire, regardless of the circumstances. In such scenarios, the fire detection circuit incorporates a relay driver that enables the transmitter to react appropriately to the fire and also notifies the owner and neighboring individuals.

**LIQUID LEVEL SENSOR:** A float switch serves the purpose of detecting the liquid level in a tank, triggering the operation of devices such as pumps, indicators, alarms, or other similar equipment. Integrated with switches for limit and alarm functions, it offers a persistent indication of the liquid level within a transformer's main tank, conservator tank, or load tap changer compartment.

#### IV. RESULTS

The project model is demonstrated for the following power system problems:

##### 4.1 LOAD SHEDDING

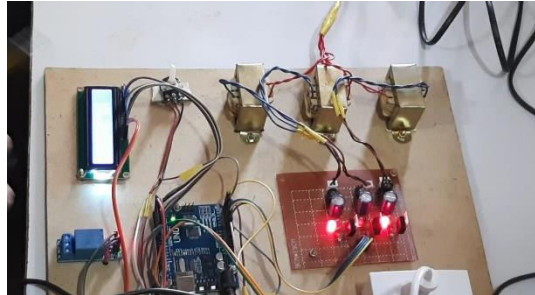


Figure 4.1(a): Creation of Load shedding problem

The load shedding should be determined and implemented by the operator. When load shedding is required, the operator will send a message regarding the load shedding through SMS to the device microcontroller. Then the microcontroller, with the assistance of the GSM modem, will read the SMS. It will then perform Load Shedding with the help of Relay and relay driver.

FOR INSTANCE: If the maximum power permitted by the power station to the particular transformer terminal is 5 Mega Watts per day, then the role of substation is to maintain the power drawn by the consumer should not be exceeded above 5 Mega Watts per day. In that case if the particular transformer terminal is drawing the power more than the permitted power given by the power station then the substation will decide to perform the load shedding to maintain the power drawn by consumers not to exceed above the permitted power given by power station so that the power shortage in the future can be bought to control. But substation should analyze the time when they want to make load shedding depending on priority. This analysis will be performed and permission will be given by the higher authority to operator to perform load shedding. In that case the operator need not to go for transformer terminal or feeder points to perform load shedding instead with the help of this project he can perform same operation through the SMS.



Figure 4.1(b): Model displaying Load shedding results

When we need to do load shedding, we send a text message saying "#LOAD ON." This helps control the power in specific areas, making sure we don't use more electricity than we have. This way, we avoid total blackouts by using the available power fairly. When load shedding isn't necessary, we send a message "#LOAD OFF" to stop this. This plan helps balance how much electricity we use and have, stopping big blackouts by sharing the available power wisely.

#### 4.2 OIL LEVEL MAINTENANCE

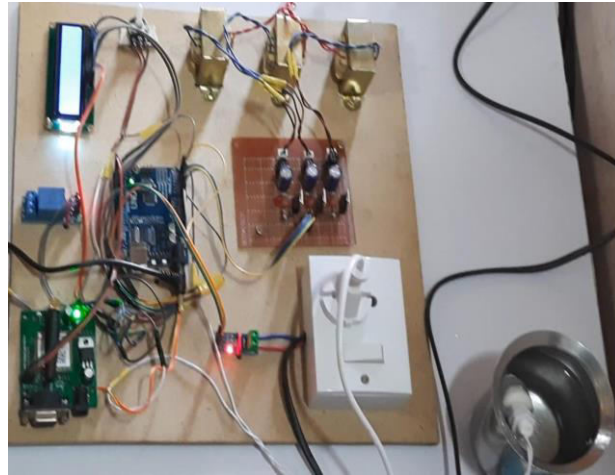


Figure 4.2(a): Creation of oil level problem

In this project we have used float level switch for oil level detection where this switch can be fixed at a predetermined level to detect the low oil level of transformer.

FOR INSTANCE: If transformer has a full tank capacity of 20 litres, then say if oil level reaches 18 litres by the heat producing inside the wall of transformer. In this case we can mount this oil level switch at the level of 18 litres inside the transformer oil tank, by which this float switch will give the low oil signal to microcontroller when the oil goes below the 18 litres. Then microcontroller will further send a warning SMS to concerned authority by which it helps in refilling the oil in particular time to the required level.

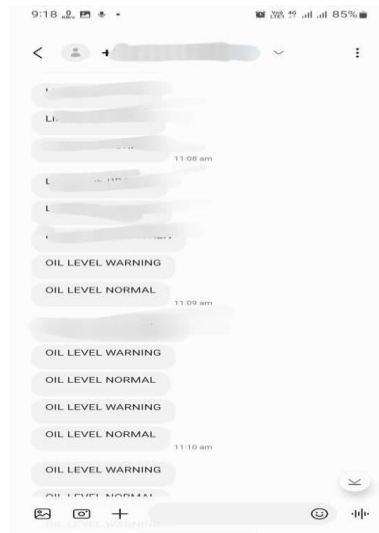


Figure 4.2(b): Model displaying oil level results

A float level switch is used to sense low oil levels in transformers. It's set at a specific level. When the oil goes below this point, it triggers an SMS alert for low oil level warning. This helps monitor and maintain proper oil levels in the transformer to ensure its efficient functioning.

### 4.3 VOLTAGE FLUCTUATION

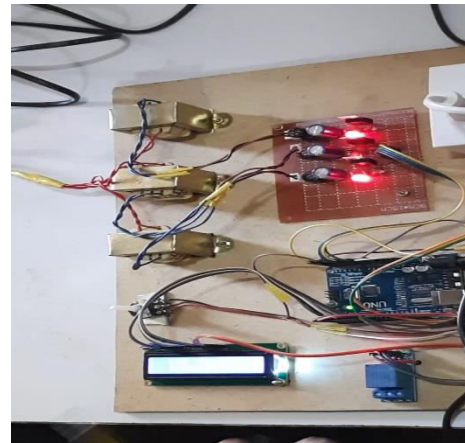
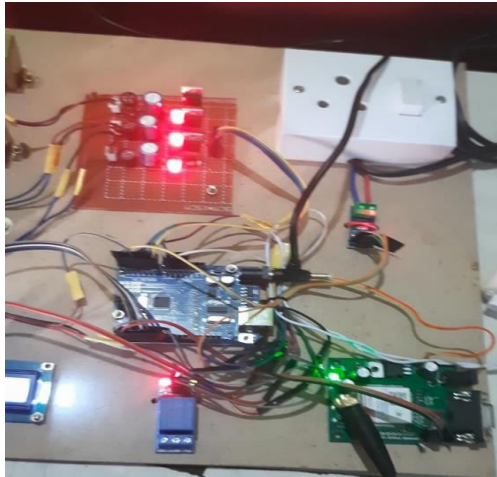


Figure 4.3(a): Creation of voltage fluctuation problem

In this project we have implemented the Voltage Fluctuation Detection with the help of voltage divider circuit with variable resistor. Here we have demonstrated voltage fluctuation for given dc voltage of 5 volts to voltage divider circuit. Here we have considered less than 3 volts as low voltage, greater than 4.5 volts as high voltage level and greater than 3 volt and less than 4.5 volts considered as normal voltage. The voltage divider circuit output is connected to analog input of microcontroller. Where the analog voltage signal will be converted to digital. further with the help of the program return to the microcontroller. Whenever voltage fluctuation detected at the analog input of microcontroller then the particular level of information (low voltage, normal voltage and high voltage) is sent to authority in the form of SMS by using the GSM modem.

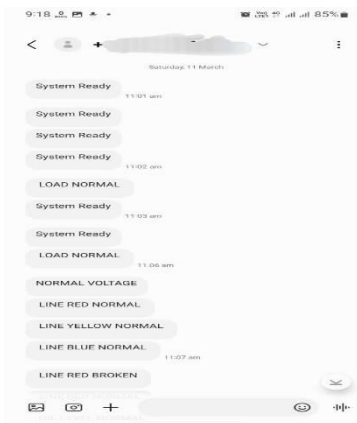


Figure 4.3(b): Model displaying voltage fluctuation results

In the event of the red line being absent from the load, an SMS alert is sent to the operator indicating "Red line broken," informing them about the line disruption.

#### 4.4 OVERLOAD DETECTION



Figure 4.4(a): Creation of overload problem

In this project we have implemented the Over load Detection with the help of Hall Effect sensors (6 Amps) to detect and measure the current across the load. Whenever the current readings exceed a certain predefined range (Here we have set the current range up to 2.5Amps as normal current and above 2.5Amps will be considered as Over Current), then the microcontroller considers it an overload condition and initiates the shutdown sequence for the transformer with the help of relay and relay driver. Additionally, an SMS is sent to the operator to notify them of the overload situation.

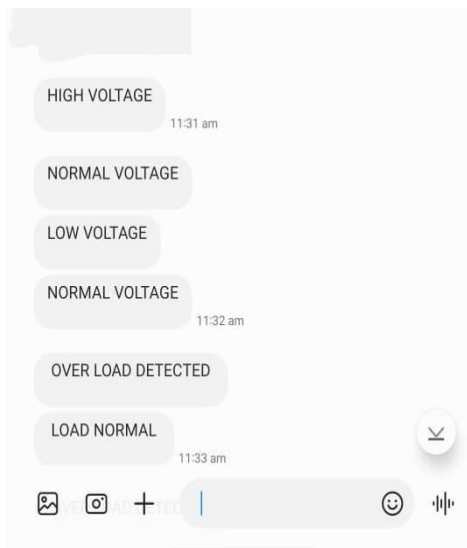


Figure 4.4(b): Model displaying overload results

When the voltage surpasses safe levels, the high voltage relay deactivates and sends an SMS alert indicating "high voltage" to the operator. Once the issue is resolved, another SMS notifies the restoration of normal voltage. Similarly, in the case of low voltage, the system functions analogously. Upon detecting under voltage, the low voltage relay triggers an SMS alert with a "low voltage" message. Once the voltage is stabilized, a subsequent SMS communicates the return to regular voltage conditions. This mechanism ensures prompt awareness and response to voltage fluctuations for maintaining equipment safety and operational efficiency.

#### V. CONCLUSION

We have accomplished the successful creation of an AI (artificial intelligence) system specifically customized for electrical power lines. This advanced system capable for detecting various issues such as Load Shedding, Voltage Fluctuation, Overloading, and Low Oil Level through the utilization of SMS messaging. Physical protection is paramount, as in rural areas which is located very far from the electricity board, to keep a separate person for maintaining to check failure like voltage fluctuation, the oil level of a transformer, phase failure, fuse blown of the system resulting in interruption of power. Load shedding tables to remember to shut down at times which is not



possible to remember for large areas. Our project continuously monitors these parameters without the actual involvement of humans in detecting failures.

Previously, embedded technology was confined to independent devices like vending machines and copiers, operating in isolation without considering their surroundings. However, with the advancement of technology enabling connectivity between devices such as mobile phones and PDAs, as well as their connection to the Internet, the potential of embedded technology has expanded. Now, it's no longer just about the individual capabilities of devices, but rather their ability to interact with other connected devices and the actions that can be achieved through these connections.

Artificial intelligence for electrical power line is developed based on implementation of embedded technology. By use of embedded system, it decreases the cost and increases dependability. This monitoring system reacts on the change of the environment and these changes can be caused by low oil level, voltage fluctuations, fuse blown, phase failure or power theft by any intruder. Embedded systems are designed with specific purpose in mind, allowing engineers to fine-tune them for optimal performance, cost-effectiveness, and compactness. Some of embedded systems produced on a large scale, benefiting from the advantages of economies of scale. These systems are found various domains of contemporary life, and numerous examples illustrate their widespread utilization. Artificial intelligence for electrical power lines uses wired and wireless networks which is used to detect low oil level, voltage fluctuations, fuse blown, phase failure or power theft embedded devices have become indispensable in sensing and controlling various systems, leading to an expansion of applications for embedded systems. This integration of microcontrollers has allowed these systems to find relevance even in domains that were not traditionally associated with conventional computers.

## VI. FUTURE ENHANCEMENT

We can use GPS Modem instead of GSM for this Device where we can solve the Problem of Network Signal Strength.

We can display and send Energy details which consumed from the transformer to Base Station.

## VII. ACKNOWLEDGEMENT

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