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REMOTE ACQUISITION AND MANAGEMENT OF GEOTHERMAL WELL DISCHARGE TEST DATA

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Geothermal Well Testing Data

ABSTRACT

Geothermal Development Company is actively engaged in the drilling of wells at the Menengai geothermal field. This increase in drilling activities has resulted in the number of wells to be measured to increase which, has a direct impact in the costs incurred in performing the discharge well monitoring through the traditional practice of physically visiting the remotely located sites. This makes the company to incur more costs in terms of man hours, operational and maintenance costs, damage to equipment's after the measurement crew have left the site and finally the integrity of the data collected as a result of different people taking readings.

This paper aims to design a remote data acquisition and management system that will be capable to overcome the above limitations. This is in a 4(four) layer approach which is comprised of metering utilities, data collection, analysis storage together with archiving and finally transmission of the data. I propose to use GPRS/GSM wireless device to interface the data collected to the communication network.

1. Introduction

Geothermal well discharge data collection is a very key step in the geothermal industry. This is because the data collected will determine the size of the power plant in terms of MWe, it will also determine the design of the Steam Gathering System (SGS) to be used, the type and size of power plant to be installed and further it will advise the Reservoir Engineers on the type of bore field they are drilling into. It will also tell the company on the number of wells to be drilled for production and reinjection. The data collected will again tell the geoscientists the radius of the extent of the main resource field.

All of the above have a great impact on cost in case the data being used to design the above is wrong. However urgent and accurate the data is required it should be collected in the most accurate manner. Procedural errors will be minimized, transport, human resource costs will be reduced and finally the time taken from data collection to analysis will be shortened.

Figure 1: Picture showing how geothermal data is collected

2. Literature Review

Geothermal well discharge data collection is a very key step in the geothermal industry. This is because the data collected determines the size of the power plant in terms of MW, it also determines the size of the steam pipe to be used and further it advises the Reservoir Engineers on the type of bore field they are drilling into. It also tells the company whether to drill more wells for power production or just a few. The data collected again tells the geoscientists the radius of the extent of the main resource field.

The above have a great impact on cost in case the data being used to design the above is wrong. This data should also be available to the designers on time as the country is way behind in achieving its target of having 5,000MWe by 2020. However urgent and accurate the data is required it should be collected in the most accurate manner. This is due to the fact that human beings have a tendency of error in form of parallax in taking readings, errors also occurs during computation of the data as a result end up in giving out wrongful data. The data collection time should be long enough so as much data is available for informed decision making instead of the 4 hours done by personnel.

The ways and means of collecting the data has always been expensive as personnel must drive everyday more than 30km from Nakuru town in order to reach the Menengai geothermal field. There has been extensive wear and tear for the vehicles being used and the rough terrain encountered leading to increased operational costs. The wells are also located at different locations in the crater thereby increasing mileage and personnel monitoring them. This should be minimized by transmitting data to the offices electronically. It not only avoids the daily travelling but also shortens the time for waiting data computed to be delivered.

High temperatures and pressure from discharging steam pipes and brine combined with poisonous gases like H_2S and CO_2 normally exposes the monitoring crew to the geothermal hazards. This paper also aims to overcome the hazards the crew will be exposed to.

The paper is therefore justified in addressing the problems as it is a holistic approach in dealing with the challenges being faced by the company in data collection. The data acquired can be stored electronically which as we know saves space and can also be stored in cloud thereby avoiding the manual typing and computation by human beings.

3. Methodology

This project mainly composes of the following components as shown in the block diagram below.

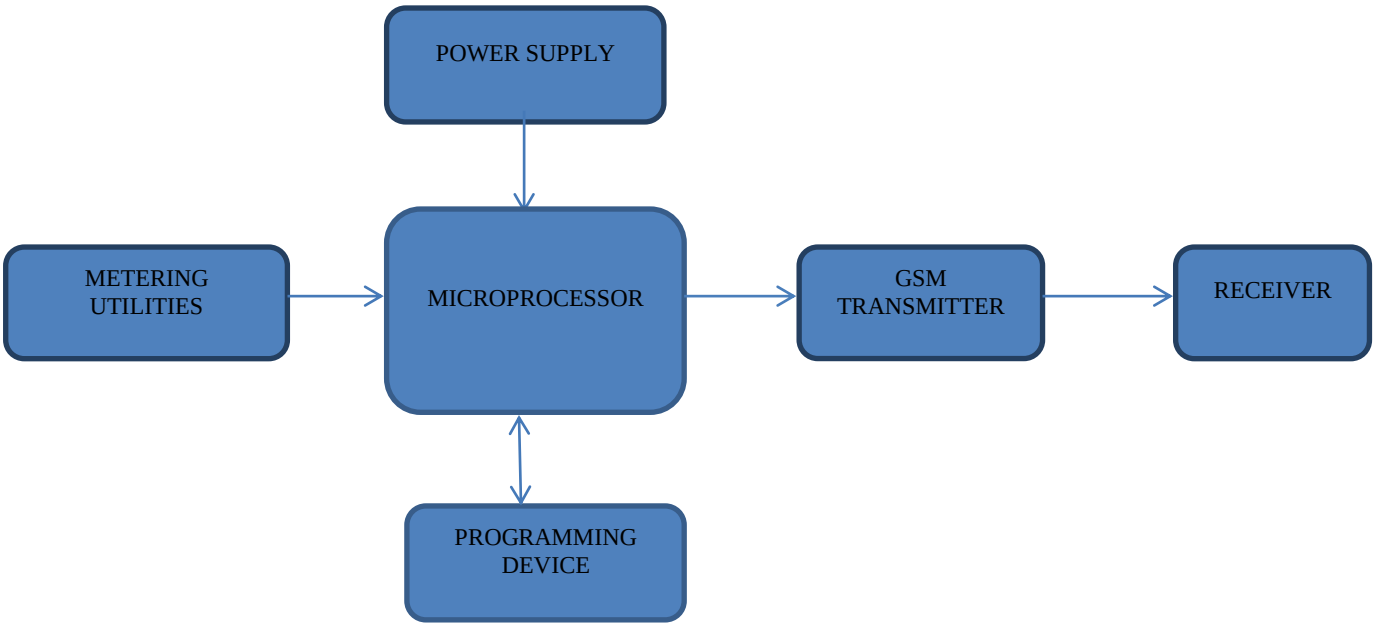

Figure 2: System overview

I. Metering Utilities

This is the part of the system is made up of utility meters that capture the data regarding the measured parameters i.e., pressures and weir height. These meters are a key element of the process so their accuracy, integrity and reliability should be carefully reviewed. Success ultimately depends on the meters thus; it starts with the selection of the correct meter to suit the application and extends to correct installation. These metering utilities give the raw data measured in form of voltage to the microprocessor for analysis.

II. Microprocessor

This is the think tank of the system where all the analysis is made. This part is made up of interfaces that enable communication with the utility meters. It is thus very essential to ensure that the equipment utilised in this part can sustain effective communication among all entities

involved in the system and should be easier to configure and manipulate. The end product of the microprocessor is now fed into the GSM transmitter.

III. GSM transmitter

This part of the system is used to interface the microprocessor to the wireless communication network. After the results of data computation have been done, the microprocessor sends a signal to the GSM modem to which it is interfaced with. Once the modem activates, it then sends an SMS to the mobile number after a certain period of time. Once the message is received, it is then stored in the memory.

IV. Power supply

The system power supply provides all the voltages required for the proper operation of the various parts of the system.

V. Programming device

This is the external programming device that is mainly a computer that can run the C++ program that is used to program the microprocessor. After programming it can be detached from the system and hence leaves it to operate on its own

3.1 Complete Circuit Diagram

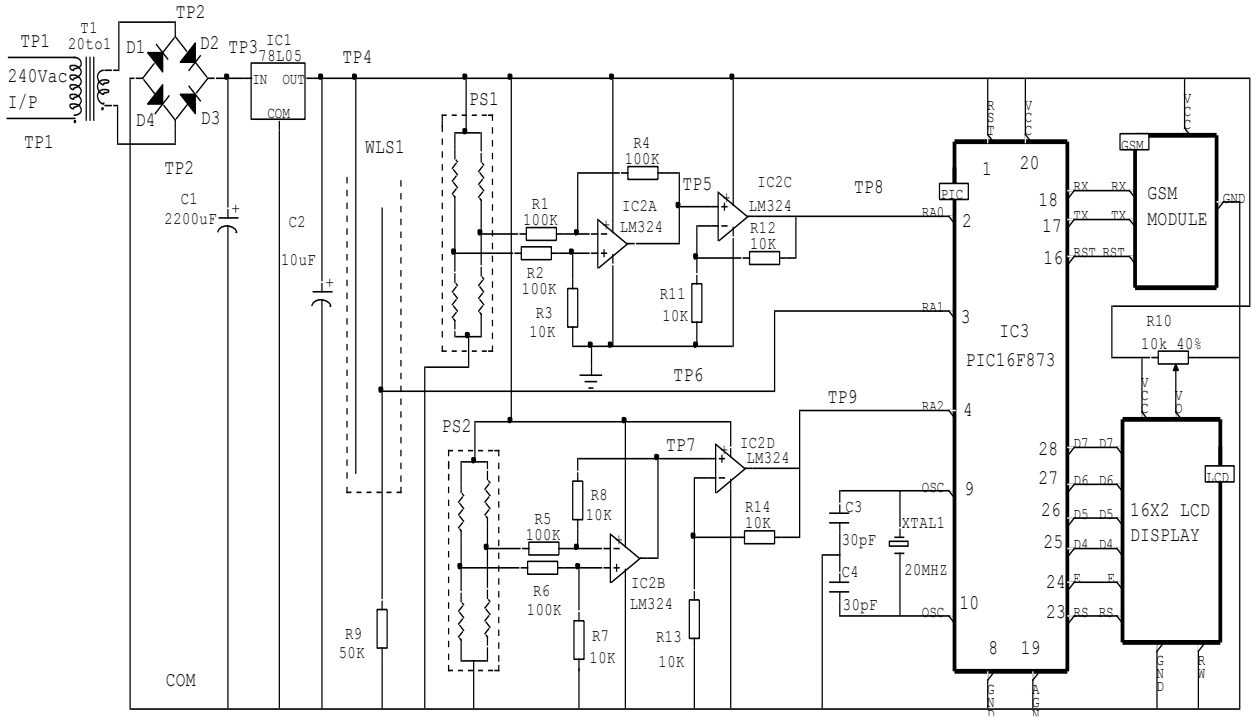

Fig 3. Complete circuit diagram

3.1 Circuit operation

The transformer steps down the mains voltage from 240V to 12V. The full wave bridge rectifier formed by D_1 to D_4 convert the a.c voltage to eliminate the ripples. The voltage regulator IC_1 regulates the rectified voltage to attain a fixed 5V output; to supply the microcontroller.

The crystal oscillator generates the operating frequency to the microcontroller.

WLS1 is the water sensor which converts the water level to an analogue voltage. PS1 and PS2 are pressure sensors for well head and lip which convert the pressure to voltage. The pressure sensor consists of a –VE output and +VE output.

The two differential amplifiers formed by IC2A and IC2B subtract the output from the sensors. The non-inverting amplifiers formed by IC2C and IC2D amplify the output from the two differentiators. The three analogue output is send to microcontroller analogue port (PORTA).

The microcontroller converts the three analogue voltages to digital. The digital data is decoded and displayed on the LCD display. The LCD display shows the three variables. The microcontroller calculates the expected power output; the output is decoded and displayed also on the LCD display. All the data displayed on the LCD display are then sent to the GSM module which sends them as an SMS to all the predetermined numbers.

4.0 RECOMMENDATIONS

Remote acquisition and management of geothermal well discharge test data should be used in Menengai geothermal field since it can have significant cost reduction.

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2.2 Sections of Your Paper <Heading 3 Style>

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