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A PATH FOR HORIZING YOUR INNOVATIVE WORK

REMOTE RAINFALL MEASUREMENT USING GSM

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Abstract: Rainfall measurement becomes very important to design flood warning systems which can wirelessly control dams. In today's times latest inventions are made to ease human efforts. The main focus is to develop a system that can produce results with minimum human efforts. To get the data like temperature, rainfall, humidity of a particular region, one has to physically be present and report the data. In this paper we describe the method of automated rainfall measurement where we employ a tipping bucket rain gauge(TBRG) to collect rainfall. The collected rainfall is maintained in a data logger and then transmitted using GSM on the operator's mobile. The system installed at the remote stations will measure the rainfall and provide the hourly update at the user end. This information can further be used to generate alerts, update the database of the metrological department and so on.

Keywords: Tipping Bucket Rain Gauge, GSM, Data Logger

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INTRODUCTION

Traditionally rainwater measuring device consist non-recording rain gauges that measure cumulative amount of rain.

The main in charge would have to personally visit the site and calculate the amount of rainfall.

Errors are introduced while measuring the rainfall as there is a tendency for water to fall out of the rain gauge if not handled properly. This manual measurement is not very accurate. The later development was a recording rain gauge which automatically records the amount of rainfall reaching the surface as a function of time.

We used a tipping bucket rain gauge which is an example of recording rain gauge. This rain gauge tips every 0.01inch of rainfall. This value can be calibrated as per our needs. At every tip a pulse is generated. We interface this tipping bucket rain gauge to a data logger which is a PIC microcontroller where the pulses are accumulated over an hour's time and then multiplied with the calibrated value of the TBRG sensor to give the rainfall measured in an hour. This measured rainfall is transmitted using GSM using Quectel M10 and the measured rainfall is displayed on the in-charge's mobile phone.

Rainfall gathering system using GPRS/CDMA has been already designed. This system uses a T-200B pluviometer produced by Norway GEONOR company as rainfall gathering equipment, Control Wave Express RTU produced by American Babcock Bristol (BB) company as controller and H7710 GPRS as wireless communication module. Dell company's dedicated server is adopted as center of the system. The variation we have introduced in this paper is GSM instead of GPRS[2].

materials and methods

We have introduced an automated rainfall measurement system where manual intervention is avoided to measure rainfall. The rainfall is automatically measured using a TBRG sensor and the cumulative amount of rainfall measured is maintained in a data logger at the station where the system is implemented. The TBRG sensor is interfaced to PIC 24F128 microcontroller to which to a pulse is sent at every tip. The tip is accumulated for an hour and then transmitted to the operator in-charge via GSM. An EEPROM is also interfaced with PIC microcontroller to store the rainfall measured in every hour as PIC has volatile memory and the data should not be lost when power is cut off. This system is powered by an external battery. Such systems are implemented at several locations and the measured rainfall is updated on the operator's

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mobile every hour along with station name. With GPRS we can even upload the information on the internet.

A. hardware

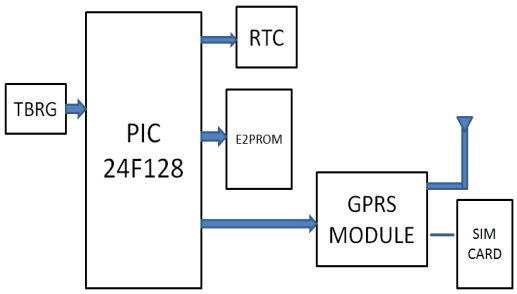

Fig 1.System Block diagram

The location of the rain gauge is very important to the successful operation of the instrument. The most accurate measurements are made in relatively sheltered areas protected from winds and storms. Openings in orchards or a grove of trees offer the best exposure for the rain gauge. Fences and other structures can be used as a protection and should not be very tall. In areas that are open with no nearby structures, a wind screen such is recommended to safeguard against wind effects.

TBRG stands for tipping bucket rain gauge. TBRG is acting as a sensor, it consist of two buckets as shown in Figure 2. The rain water would be collected in these bucket and a predefined value is set as a reference value, consider it as a 0.01 inches(or 0.25mm). This reference value could be changed as per the requirement. Bucket 1 will collect the rain water first ,and as the water reaches the predefined value that is the reference value the bucket 1 will tip. And during this one tip one pulse would be generated. Meanwhile the bucket 2 will start collecting the rain water and the process is repeated again. Each time the tipping of the bucket takes place the pulse is created. TBRG consist of a reed switch which closes momentarily making the electrical contact which could be used for recording instruments.[3]

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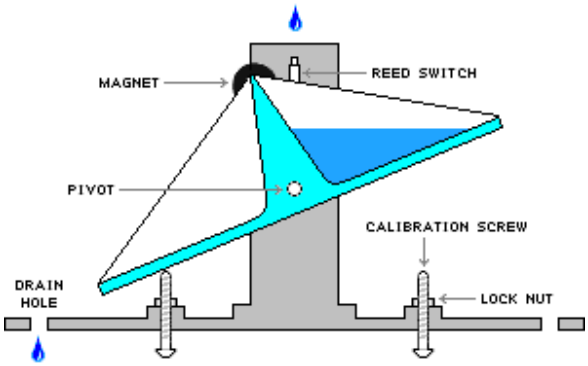

Figure 2.Working of TBRG

Consider the bucket tips for 200 times. The reference value set would be equal to 0.25mm. thus the rain collected in 200 tips of bucket would be equal to (200*0.25mm) 50mm.

This calculations would be done by the PIC24F128.PIC24F128 is 64 pin 16 bit microcontroller. It consist of 8MHz internal oscillator and 32MHz external oscillator. Also it consist of 16 channel A/D convertor, on chip flash memory having 20 years retention minimum. It consist of 64kbps of memory and thus to store the results an EEPROM 24C512 is attached to the circuit. This data is then displayed on LCD . The LCD will consist the information in the following format.

Date: 27/2/2014

Time: 3.19 pm

Pulse :50mm

This format will be displayed on LCD and will be observed at transmitter section. To have proper date and exact time we require RTC a real time clock DS1338. Now the data would be then transmitted using quectalm10 a GSM/GPRS module. This data will then be sent using AT commands in the form of messages. The code will also consist of the mobile number on which the data could be sent immediately as an when required. At the receiver section we have the mobile on which the data displayed on LCD would be in form of message. The other way could be using GPRS instead to go with GSM. The advantage we get using GPRS module is that the data will be transmitted in the form of packets and thus less chances of losing the data . In this case the receiver section will consist of same module present at the transmitter side. The data would be then transmitted and could be received at the receiver side using GPRS receiver. This received data could be then uploaded directly on the net for which we require web access. Or

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the data received could be then stored in the form of the excel sheets. Thus on the basis of results obtain we could estimate approximately the rainfall in particular area.

b. Software

1] Begin.

2] Initialise ports, LCD and UART.

3] LCD write routine. The LCD displays title of the project "Automated rainfall measurement system."

4] Setting and configuration handling. Specifying the mobile no.

5] Configuration of EEPROM.

6] GSM initialisation. Send AT commands and prepare the module to transmit SMS.

7] While loop(infinite loop) contains continuous reading of RTC and TBRG value.

8] Display the rainfall measurement on LCD.

9] As the update time arrives the system generates an SMS which is received at the user end.

10] End

RESULTS AND DISCUSSION

The system generates an SMS in the following pattern.

TIME: 9:00 am

RAINFALL: 120mm

This information is displayed on the operator's mobile phone or the person in charge.

a. Advantages

The sensor i.e the TBRG can be calibrated according to the rainfall pattern of the area. The LCD continuosly displays the rainfall at the location. The time interval between updates using GSM can be varied according to our interest. Once installed it requires no human interference but maintenance has to be carried out at regular intervals.

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b. Disadvantages

Installation cost would be more and the system may not be highly reliable because the measure rainfall is transmitted using GSM which may get lost due to network problems.

CONCLUSION

This system is a remote rainfall measurement device where the rainfall measure is transmitted via GSM to the receiver's mobile phone. A TBRG is used to measure the rainfall which is a recording rain gauge. An eeprom is interfaced with the microcontroller to store the data which can be lost if the system loses power. A Quectel M10 GSM module is used which is robust as compared to other modules and can be used for longer durations. Manual intervention is not required to measure the rainfall. These systems can be installed at many locations and the information about the rainfall received by these areas can be conveyed to the operator sitting at the central station. The system can be further modified using GPRS to transmit the information about the rainfall received which has already been implemented and is much reliable than GSM. Such systems can be also used in flood warnig systems to wirelessly control the dams based on remote rainfall measurement.

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