



Implementation of Real Time Data Logging System Using ARM Microcontroller

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ABSTRACT

The rapid advancement in embedded systems and the growing need for real time monitoring have increased the demand for efficient data logging solutions in various applications such as industrial automation, environmental monitoring, healthcare and smart agriculture. This paper presents the design and implementation of a real time data logging system using an ARM microcontroller. The proposed system acquires data from sensors, processes it in real time and stores it in non volatile memory or cloud server for further analysis. The ARM _ microcontroller offers high performance, low power consumption and multiple peripheral interfaces, making it suitable for real time data logging applications. The system integrates temperature, humidity and other environmental sensors, and uses an SD card or wireless module for data storage and transmission. The results show that the implemented system is reliable, accurate and capable of continuous real time data logging with minimal latency. The proposed model can be effectively used in industrial, IoT based and research applications for continuous monitoring and analysis.

Index Terms — Data Logging, ARM Microcontroller, Real Time Monitoring, Embedded System, IoT, Sensors.

INTRODUCTION

In recent years, real time data acquisition and logging have become essential in many fields, including industrial monitoring, environmental tracking, healthcare, smart cities and IoT applications. Traditional data logging systems often face limitations in terms of processing speed, memory capacity and power efficiency. ARM microcontrollers, with their high processing capability, low power consumption and rich peripheral support, provide an effective solution for implementing real time data logging systems. A real time data logging system continuously collects data from sensors, processes it and stores it for further analysis. This system helps in understanding system behaviour, detecting abnormal conditions and making informed decisions. This paper focuses on the design and implementation of a real time data logging system using an ARM microcontroller, which can acquire, store and transmit sensor data efficiently.

The ARM microcontroller is programmed to read data from various sensors such as temperature, humidity, light and pressure sensors. The collected data is time stamped and stored in an SD card or transmitted to a cloud server using Wi-Fi/GSM module. The system is designed to operate in real time with high accuracy and minimal delay. The proposed model can be used for applications like environmental monitoring, industrial process control, smart agriculture and IoT based systems.

SCOPE OF THE STUDY

This study aims to design and implement a real time data logging system using an ARM microcontroller for continuous monitoring of sensor data,

- e The study identifies key factors that affect the performance of the data logging system, such as sensor accuracy, data storage, real time processing and communication.
- e The system can be extended for various applications including industrial automation, — environmental monitoring, healthcare systems and smart IoT solutions.
- e = The scope of the study is limited to the implementation of real time data logging using an ARM microcontroller with basic environmental sensors and data storage modules.

REVIEW OF LITERATURE

“S. M. Ibrahim, A. R. Al-Ali, and M. A. Al-Qutayri”, 2018 in their research paper “Design and Implementation of Real Time Data Logger using ARM Microcontroller” proposed a data logging system using an ARM Cortex-M microcontroller for environmental monitoring. The system was capable of real time data acquisition, storage and wireless transmission. Their results showed high accuracy, reliability and low power consumption, making it suitable for IoT and industrial applications. They suggested that the use of ARM based systems can significantly improve the performance and efficiency of real time monitoring applications.

REVIEW OF LITERATURE (CONTINUED)

“Smith, Kumar and Lee”, 2019 in their research paper “Real Time Data Acquisition and Monitoring using ARM Microcontroller” found that ARM based systems provide high performance, low power consumption and better real time processing for data logging applications. They suggested that ARM microcontrollers are widely used in industrial and environmental monitoring due to their advanced features and multiple peripheral interfaces.

“R. Patel, M. Sharma and S. Gupta”. 2020 in their research paper “Design and Implementation of IoT Based Data Logger using ARM” found that real time data logging systems using ARM microcontrollers can efficiently acquire, store and transmit sensor data to cloud platforms. They suggested that such systems are highly reliable and can be used for various applications including healthcare monitoring, smart agriculture and industrial automation.

OBJECTIVES OF THE STUDY

The objectives of the study are as follows:

- e To design and implement a real time data logging system using an ARM microcontroller.
- e To study the performance and accuracy of the proposed data logging system.
- e To analyze the data acquisition, storage and transmission process in real time.
- e To offer suitable suggestions for improving the efficiency and reliability of the system.

HYPOTHESES

HOI: There is no significant relationship between the type of sensor used and the accuracy of data recorded in the real time data logging system using an ARM microcontroller.

GEOGRAPHICAL AREA

The study is mainly focused on the implementation and testing of a real time data logging system in a controlled environment at NEELKANT Institute of technology, India. The experimental setup can be used for monitoring environmental parameters in various locations such as laboratories, industrial areas and smart agriculture fields.

METHODOLOGY

The study is based on both primary and secondary data. The required data has been collected through the implementation and testing of the real time data logging system using an ARM microcontroller. Primary data has been collected by observing the

actual performance of the system, sensor readings and data stored in SD card or transmitted to a cloud server. Secondary data has been collected from various books, research papers, journals and reliable websites related to. embedded systems and IoT.

SAMPLING DESIGN

Since it is an experimental and descriptive study, a convenience sampling method of non-probability sampling will be adopted. The sample has been taken from different sensor data readings collected during the implementation and testing of the system in NEELKANT Institute of technology.

TOOLS FOR ANALYSIS

The data collected has been processed further with the help of appropriate software tools to analyze and interpret the data in the study, The following tools have been used namely,

¢ = Data visualization using MATLAB/Excel

e Statistical analysis (Mean, Standard Deviation)

¢ Comparative analysis of sensor data

e Performance evaluation metrics (Accuracy, Response Time, Memory Usage)

DATA PROCESSING

After completing the data collection work, the recorded sensor data were processed to ensure correctness and completeness. The data were then organized, cleaned and coded. The tabulation and analysis of data have been done using MATLAB and MS Excel software to evaluate the performance of the real time data logging system,

LIMITATIONS OF THE STUDY

¢ The study is limited to the implementation of a real time data logging system using an ARM microcontroller in a controlled environment. Hence, the findings may not be generalized to all real world applications.

e = The researcher deals only with selected environmental sensors and does not focus on advanced communication technologies or large scale industrial applications.

DATA ANALYSIS AND INTERPRETATION

The researcher has made an attempt to analyse the performance of the proposed real time data logging system using an ARM microcontroller. The respondents/observations were classified based on various parameters such as type of sensor, mode of data storage, communication method and application area.

PREFERENCE OF SENSORS USED IN THE SYSTEM

The researcher has gathered information about the category of sensors used in the real time data logging system. The information is displayed in Table 1.

TABLE 1. PREFERENCE OF SENSORS USED IN THE SYSTEM

S. No.	Type of Sensor	No. of Observations	Per cent
1	Temperature Sensor	28	35.00
2	Humidity Sensor	22	27.50
3	Pressure Sensor	15	18.75
4	Light Sensor	10	12.50

5	Other Sensors	5	6.25
	Total	80	100.00

Source: Primary Data

INTERPRETATION

From the analysis of the Table 1, it is understood that out of 80 observations, a majority of 35.00 per cent of the system implementations used temperature sensor, 27.50 per cent used humidity sensor, 18.75 per cent used pressure sensor, 12.50 per cent used light sensor and the remaining 6.25 per cent used other sensors.

It is understood that a majority of 35.00% of the implementations have used temperature sensor in the study.

MODE OF DATA STORAGE

The researcher has gathered information about the category of data storage methods used in the system. The information is displayed in Table 2.

TABLE 2. MODE OF DATA STORAGE

S. No.	Data Storage Method	No. of Observations	Per cent
1	SD Card	40	50.00
2	EEPROM	12	15.00
3	Cloud Server	20	25.00
4	PC/Laptop (Serial)	8	10.00
	Total	80	100.00

Source: Primary Data

COMMUNICATION METHOD USED

ih Data Storage Method on Ne cS Per cent 1 SD Card 40 50.00 2 EEPROM 12 15.00 3 Cloud Server 20 25.00 4 PC/Laptop (Serial) 8 10.00 Total 80 100.00 Source: Primary Data From the analysis of the Table 2, it is understood that out of 80 observations, a majority of 50.00 per cent of the implementations have used SD card for data storage, 25.00 per cent used cloud server, 15.00 per cent used EEPROM and the remaining 10.00 per cent used PC/ laptop (serial). It is understood that a majority of 50.00%

TABLE 3. COMMUNICATION METHOD USED

S. No.	Communication Method	No. of Observations	Per cent
1	Wi-Fi Module	30	37.50
2	GSM/GPRS Module	18	22.50
3	Bluetooth Module	14	17.50
4	USB (Serial)	10	12.50
5	Other Methods	8	10.00
	Total	80	100.00

Source: Primary Data

INTERPRETATION

From the analysis of the Table 2, it is understood that out of 80 observations, a majority of 50.00 per cent of the implementations have used SD card for data storage, 25.00 per cent used cloud server, 15.00 per cent used EEPROM and the remaining 10.00 per cent used PC/ laptop (serial). It is understood that a majority of 50.00%

APPLICATION AREA OF THE SYSTEM

The researcher has gathered information about the category of communication methods used for data transmission in the real time data logging system. The information is displayed in Table 3.

TABLE 4. APPLICATION AREA OF THE SYSTEM

S. No.	Application Area	No. of Observations	Per cent
1	Environmental Monitoring	28	35.00
2	Industrial Automation	20	25.00
3	Agriculture Monitoring	14	17.50
4	Healthcare Monitoring	10	12.50
5	Other Applications	8	10.00
	Total	80	100.00

Source: Primary Data

TABLE 8. SENSOR PERFORMANCE ANALYSIS

Parameters	I	II	III	IV	V	Total
Accuracy of sensor data	12	8	6	42	12	80
Reduce power consumption	10	6	8	40	16	80
Real time data transmission	15	12	10	32	11	80
Data storage reliability	9	7	5	45	14	80
System cost	10	4	9	15	42	80
Total	80	80	80	80	80	80

Source: Primary Data

TABLE 9. PERCENTAGE OF POSITION AND GARRETT VALUE

Rank	$100(R_{ij} - 0.5)/N_j$	Calculated value	Garrett value
1	$100(1-0.5)/5$	10	75
2	$100(2-0.5)/5$	30	60
3	$100(3-0.5)/5$	50	50
4	$100(4-0.5)/5$	70	40
5	$100(5-0.5)/5$	90	25

Source: Primary Data

TABLE 10. GARRETT RANKING MULTIPLICATION

S. No.	Parameters	I	II	III	IV	V	Total
1	Accuracy of sensor data	900	480	300	1680	300	3660
2	Reduce power consumption	750	360	400	1600	400	3510
3	Real time	1125	720	500	1280	275	3900

	data transmission						
4	Data storage reliability	675	420	250	1800	350	3495
5	System cost	750	240	450	600	1050	3090

Source: Primary Data

TABLE 11. FACTORS INFLUENCING THE SELECTION OF DATA LOGGING SYSTEM

S. No.	Parameters	Total Score	Average Score	Rank
1	Accuracy of sensor data	3660	45.75	II
2	Reduce power consumption	3510	43.88	III
3	Real time data transmission	3900	48.75	I
4	Data storage reliability	3495	43.69	IV
5	System cost	3090	38.63	V

Source: Primary Data

GARRETT RANKING METHOD

Garrett ranking method

The Garret ranks are calculated by using appropriate Garrett ranking formula. Then based on the Garrett table values have been ascertained. The Garrett table values and scores of each rank in Table 9 are multiplied to record scores in Table 10.

$$\text{Percent position} = 100(R_{ij} - 0.5)/N_j$$

Where,

R_{ij} = Rank given for i^{th} item by the j^{th} sample respondents N_j = Total rank given by the j^{th} sample respondents.

SUGGESTIONS

It is suggested that the system can be further improved by using low power sensors and efficient power management techniques to increase the battery life.

A cloud based data storage option should be integrated to provide remote access and real time monitoring of data.

The system should include wireless communication technologies such as Wi-Fi or GSM to enable continuous and reliable data transmission.

A user friendly interface or mobile application can be developed to visualize real time data for better monitoring and decision making.

The system should be made cost effective so that it can be widely used in industrial, environmental and agriculture applications.

Further, advanced features such as data analytics and. anomaly detection can be added to enhance the performance and reliability of the system.

CONCLUSION

In this project we have found that a real time data logging system using an ARM microcontroller is effective and reliable for continuous monitoring and recording of sensor data, The system provides accurate data acquisition, efficient storage and real time transmission. It can be used in various applications such as environmental monitoring, industrial automation, healthcare

and agriculture. Hence, the implementation of real time data logging system using an ARM microcontroller is a cost effective and efficient solution for modern monitoring needs.

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