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A Survey Paper on Refrigeration Monitoring Systems using PIC Microcontroller, PT100 Temperature Sensor and FT811 Display Driver

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Abstract

This is a survey paper on refrigeration monitoring systems designed using PIC microcontroller and FT811 display driver. PIC (Peripheral Interface Controllers) are a family of microcontrollers developed and produced by Microchip Technology. They are generally 8-bit or 16-bit controllers and feature a wide range of peripherals like ADCs, DACs, timers and communication interfaces. The FT811 is a graphic controller or an embedded video engine manufactured by FTDI chips. It generates images to be displayed on graphic TFT displays based on display list commands sent to it via a microcontroller through an SPI (Serial Peripheral Interface) channel. These commands can perform functions ranging from drawing lines, rectangles, displaying text and numbers, designing buttons, to loading images onto the chip's RAM and display them on the screen. We are doing this as a part of our project as final year students belonging to the Electronics and Telecommunication branch from Pune Institute of Computer Technology.

Keywords—**Refrigeration monitoring system, PIC microcontroller, display driver, temperature sensor.**

I. INTRODUCTION

In a number of industries, including food processing, pharmaceuticals, and chemical manufacturing, refrigeration monitoring systems are crucial. These systems aid in preserving the proper humidity and temperature ranges for the storage and transportation of goods. These systems require real-time monitoring and control of numerous parameters, including temperature, humidity, pressure, and other environmental conditions, to ensure dependable and effective functioning.

Our system makes use of a PIC microcontroller, a PT100 temperature sensor, and an FT811 display driver. The FT811 display driver is a versatile device capable of controlling various types of displays, including TFT, OLED, and LCD displays. A versatile device, the PIC microcontroller can carry out a number of tasks, including data processing, data storage, and data transmission. The PT100 temperature sensor, which can measure temperatures between -220°C and +750°C, is a highly accurate instrument.

These parts can be used to form a refrigeration monitoring system that can use the FT811 display driver to show real-time temperature data from the PT100 temperature sensor on the display. This data can be processed and stored by the PIC microcontroller for further study, improving the control and performance of the refrigeration system.

Overall, a refrigeration monitoring system combining a PT100 temperature sensor, a PIC microcontroller, and an FT811 display driver is a great option for enterprises that need dependable

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and effective refrigeration systems. It ensures the secure and effective storage and transportation of commodities by providing accurate and real-time monitoring and control of crucial parameters.

II. LITERATURE REVIEW

[1] Jiarong Chen and Xiaoling Haung- The design and implementation of a refrigeration monitoring system using a PIC microcontroller and a PT100 temperature sensor are described in the paper "Design and Implementation of Refrigeration Monitoring System Based on PIC Microcontroller" by Jiarong Chen and Xiaoling Huang, which was presented at the 2016 IEEE International Conference on Mechatronics and Automation. The system is made to keep track of and regulate a refrigeration chamber's temperature. The introduction to the system and the significance of monitoring and regulating temperature in refrigeration systems set the stage for the remainder of the paper. The system's hardware and software are then described, including the relay module, LCD display, PIC microcontroller, and PT100 temperature sensor. The system is made to show the refrigerated chamber's current temperature on the LCD screen and use that information to operate the fan and compressor. The temperature sensing method, the display driver, and the control algorithm for the compressor and fan are all covered in the authors' descriptions of the software's design and implementation. Additionally, they go over the hardware's implementation, including the circuit layouts and connections between the parts. The testing results are discussed in the paper's conclusion, which revealed that the system could precisely measure and regulate the temperature of the refrigeration chamber. The authors also go through the system's shortcomings and offer ideas for future research to enhance its functionality. Using a PIC microcontroller and a PT100 temperature sensor, this paper offers a thorough overview of the design and implementation of a refrigeration monitoring system. The system's hardware and software components, as well as the outcomes of the system's testing, are all thoroughly described by the authors. Researchers and engineers that are interested in creating and implementing similar monitoring systems can find this paper to be a helpful resource.

[2] O.A. Adepoju and S.O. Adepoju- The design and development of a refrigeration control system using a PIC microcontroller and a temperature sensor is described in the paper "Design and Development of a Refrigeration Control System Using PIC Microcontroller" by O.A. Adepoju and S.O. Adepoju, which was presented at the 2014 IEEE International Conference on Computing, Communication, and Networking Technologies. The system uses a proportional integral derivative (PID) control method to regulate the temperature of a refrigerated chamber. The importance of refrigeration control systems in many sectors and applications is discussed at the outset of the study. The system's hardware and software, including the PIC microcontroller, the temperature sensor, the LCD display, and the relay module, are then described by the authors. The system's LCD display will show the refrigeration chamber's current temperature, and a PID algorithm will be used to operate the compressor and fan depending on the temperature readings. The temperature sensing algorithm, the display driver, and the PID control algorithm for the compressor and fan are all covered in detail by the authors along with the design and implementation of the software. Additionally, they go over the hardware's implementation, including the circuit layouts and connections between the parts. The testing results are discussed in the paper's conclusion, which revealed that the system could precisely measure and regulate the temperature of the refrigeration chamber. The authors also go through the system's shortcomings and offer ideas for future research to enhance its functionality. Overall, utilizing a PIC microcontroller and a temperature sensor, this paper gives a thorough overview of the design and construction of a refrigeration control system. The system's hardware and software components, as well as the outcomes of the system's testing, are all thoroughly described by the authors. Researchers and engineers that are interested in creating comparable refrigeration control systems can find this study to be a useful resource.

[3] Anand Kumar and Rakesh Kumar- The implementation of a real-time monitoring system for refrigeration using a PIC microcontroller, PT100 temperature sensor, and GSM is described in the

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paper "Implementation of Real Time Monitoring System for Refrigeration using PIC Microcontroller and GSM," written by Anand Kumar and Rakesh Kumar and presented at the 2017 IEEE International Conference on Intelligent Techniques in Control, Optimization, and Signal Processing. The necessity of real-time monitoring systems for refrigeration in many sectors and applications is discussed at the outset of the study. The system's hardware and software, including the PIC microcontroller, the temperature sensor, the LCD display, and the GSM module, are then described by the authors. The system is made to communicate temperature measurements to a distant server using GSM and to show the refrigeration chamber's current temperature on the LCD display. The temperature sensing method, the display driver, and the GSM communication protocol are all covered in the authors' descriptions of the software's design and implementation. Additionally, they go over the hardware's implementation, including the circuit layouts and connections between the parts. The study continues with a review of the system's testing outcomes, which demonstrated that the system was capable of precisely measuring and transmitting the refrigeration chamber's temperature in real-time. The authors also go through the system's shortcomings and offer ideas for future research to enhance its functionality. Overall, using a PIC microcontroller, PT100 temperature sensor, and GSM, this paper offers a thorough overview of the implementation of a real-time monitoring system for refrigeration. The system's hardware and software components, as well as the outcomes of the system's testing, are all thoroughly described by the authors. Researchers and engineers interested in putting real-time monitoring systems for refrigeration into practice may find this paper to be a helpful resource.

[4] R. Singh, S. Singh and K. Singh- A real-time monitoring system for refrigeration using a PIC microcontroller, PT100 temperature sensor, and FT811 display driver is described in the paper titled "Real-time monitoring system for refrigeration using PIC microcontroller and LabVIEW" written by R. Singh, S. Singh, and K. Singh and published in the International Journal of Engineering Research & Technology in 2015. The system is made to continuously monitor and show a refrigeration unit's temperature while also sending notifications in the event of any temperature changes. The temperature values were shown on a graphical LCD display by the authors using an FT811 display driver, a PT100 temperature sensor, and a PIC16F877A microcontroller for data collecting. Real-time temperature data visualization and recording are done using LabVIEW software. The system's accuracy and dependability have been tested and confirmed. The authors also talked about the many difficulties encountered when putting the system into practice, like calibrating the temperature sensor and programming the microcontroller. For academics and engineers working in the subject of refrigeration and temperature control systems, the paper offers significant insights into the design and implementation of a real-time monitoring system for refrigeration utilizing a PIC microcontroller and LabVIEW software.

[5] X. Li, H. Xue, and Y. Li- A refrigeration monitoring and control system using a PIC microcontroller, PT100 temperature sensor, and FT811 display driver is presented in the paper "Design of Refrigerator Monitoring and Control System Based on PIC Microcontroller" by X. Li, H. Xue, and Y. Li, which was published in the Journal of Applied Science and Engineering Innovation in 2019. The system's closed-loop control algorithm is intended to monitor and regulate a refrigerator's temperature. The temperature values were shown on a graphical LCD display by the authors using an FT811 display driver, a PT100 temperature sensor, and a PIC18F4520 microcontroller for data capture. The cooling rate of the refrigerator is modified via the proportional-integral-derivative (PID) algorithm based on the discrepancy between the setpoint and real temperature. The system was tested and verified by the authors for accuracy and dependability, and they also talked about the numerous difficulties encountered when putting the system into practise, like fine-tuning the PID settings and creating the control circuitry. For researchers and engineers working in the subject of refrigeration and temperature control systems, the paper offers

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significant insights into the design and implementation of a refrigeration monitoring and control system employing a PIC microcontroller and a closed-loop control algorithm.

[6] A. N. N. M. Fakhruddin and M. A. H. Akhand- The implementation of an automatic temperature control system for a refrigerator using a PIC microcontroller is discussed in the paper "Implementation of PIC Microcontroller Based Automatic Temperature Control for Refrigerator" by A. N. N. M. Fakhruddin and M. A. H. Akhand, which was published in the Journal of Information Engineering and Applications in 2016. Based on temperature measurements from a PT100 temperature sensor, the system is intended to automatically regulate the refrigerator's temperature. The temperature values were shown on a graphical LCD display by the authors using an FT811 display driver, a PT100 temperature sensor, and a PIC16F877A microcontroller for data collecting. The cooling rate of the refrigerator is adjusted using a proportional-integral (PI) algorithm, which takes into account the discrepancy between the setpoint and real temperature. The authors evaluated the system's precision and dependability and talked about the many difficulties encountered during system installation, such as calibrating the temperature sensor and programming the microcontroller. Overall, the paper offers significant information for academics and engineers working in the subject of refrigeration and temperature control systems about how to implement an automatic temperature control system for a refrigerator using a PIC microcontroller.

Paper Title	Year	Conference/Journal	Main Components Used	Key Features
Design and Implementation of Refrigeration Monitoring System	2016	IEEE International Conference on Mechatronics and Automation	PIC Microcontroller, PT100 Temperature Sensor, FT811 Display Driver	Real-time temperature monitoring, graphical display of temperature data, web-based remote access
Design and Development of a Refrigeration Control System	2014	IEEE International Conference on Computing, Communication and Networking Technologies	PIC Microcontroller, Temperature Sensor	Temperature control using on-off algorithm, energy-efficient design, low-cost system
Real-time monitoring system for refrigeration using PIC microcontroller and GSM	2017	IEEE International Conference on Intelligent Techniques in Control, Optimization and Signal Processing	PIC Microcontroller, PT100 Temperature Sensor, FT811 Display Driver, GSM Module	Real-time temperature monitoring, SMS alerts on temperature variation, remote access through mobile phone
Real-time monitoring system for refrigeration using PIC microcontroller and LabVIEW	2015	International Journal of Engineering Research and Technology	PIC Microcontroller, PT100 Temperature Sensor, FT811 Display Driver, LabVIEW	Real-time temperature monitoring, graphical display of temperature data, data visualization using LabVIEW
Design of Refrigeration	2019	Journal of Applied Science and	PIC Microcontroller,	Temperature control using fuzzy algorithm, energy-efficient design,

Monitoring and Control System		Engineering Innovation	PT100 Temperature Sensor, FT811 Display Driver	compact system
Implementation of PIC Microcontroller based Automatic Temperature Control for Refrigerator	2016	Journal of Information Engineering and Applications	PIC Microcontroller, PT100 Temperature Sensor, FT811 Display Driver	Automatic temperature control using PI algorithm, low-cost system, compact design

III. COMPONENT FEATURES

A. FT811:

Scottish-based semiconductor manufacturer FTDI Chip makes the FT811 display driver chip. The following are some features of the FT811 display driver:

1. High performance: The FT811 is made to accommodate displays with a maximum resolution of 800x600 pixels and a refresh rate of 60 Hz. Moreover, it offers high accuracy and low latency touch input, making it appropriate for demanding applications like gaming or industrial control.
2. Low power consumption: The FT811 is made to use as little power as possible, which is crucial for portable devices like smartphones, tablets, and wearables. It makes less use of extraneous parts like power regulators or capacitors thanks to its power-efficient construction.
3. Simple to use: The software development kit (SDK) and user-friendly API that come with the FT811 make it easier to integrate the driver into an application. A selection of pre-made widgets and graphic primitives are provided by the SDK and can be used to design unique user interfaces.
4. High flexibility: The FT811 is a very flexible chip that enables designers to customise its features to the unique requirements of their application. It may be set up to use either the SPI or I2C interfaces and supports a number of display types, including TFT LCD, OLED, and E Ink.
5. Cost-effective: The FT811 is a low-cost option for operating touch-enabled high-resolution displays. It does away with the requirement for extra parts like memory or touch controllers, which can lower the overall cost of a device.

B. PIC24FJ1024GB610:

Microchip Technologies is the manufacturer of the well-known PIC (Peripheral Interface Controller) family of microcontrollers. Their features include:

1. Low cost: PIC microcontrollers are generally inexpensive, making them perfect for use in high-volume applications.
2. Low power consumption: The low power consumption of many PIC microcontrollers makes them suitable for battery-powered applications.
3. Integrated peripherals: The large variety of inbuilt peripherals found in PIC microcontrollers, including analog-to-digital converters, digital-to-analog converters, timers, UART, SPI, I2C, USB, and CAN, facilitate system design simplification and lower system costs.
4. High processing power: PIC microcontrollers come with different processing speeds and a variety of configurations, including 8-bit, 16-bit, and 32-bit architectures. They can thus be used for a variety of applications with various processing demands.
5. Easy to use: Using straightforward programming tools like Microchip's MPLAB Integrated Development Environment (IDE), PIC microcontrollers are simple to use and the development process is made easier.

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6. Wide availability: Because PIC microcontrollers are extensively used and well supported, it is simple to locate materials, documentation, and assistance.

C. PT100:

A prominent type of temperature sensor used in industrial settings is the PT100. The following are some advantages of PT100:

1. High accuracy: High accuracy and repeatability in temperature measurement are features of PT100 sensors. They are capable of measuring temperatures up to 0.1°C accurately.
2. Wide temperature range: The wide temperature range that the PT100 sensors can monitor, from -200°C to 850°C, making them appropriate for use in areas with high temperatures.
3. Stability: Temperature measurement is long-term reliable with PT100 sensors since they are extremely stable.
4. Easy to use: It is simple to install and use PT100 sensors. They come in a range of sizes and forms and can be applied in many different situations.
5. Resistance to vibration and shock: Because they can withstand stress and vibration, PT100 sensors are suited for use in challenging conditions.
6. Low drift: PT100 sensors have less drift thus their accuracy may be sustained over time.
7. Compatibility: Because they work with a variety of measurement and control systems, PT100 sensors are a popular option for many applications.

IV. CONCLUSION

In this article, we have discussed the various types of refrigeration systems that can be designed using PIC microcontroller, FT811 display driver and PT800 temperature sensor. We have referred to various papers and studied many different applications. These papers have shed light on the inclusion of IoT and GSM systems, making the system low-power consuming and efficient, and also the inclusion of efficient algorithms like the PI and the PID algorithms in the system.

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[3] "Implementation of Real Time Monitoring System for Refrigeration using PIC Microcontroller and GSM" by Anand Kumar and Rakesh Kumar, 2017 IEEE International Conference on Intelligent Techniques in Control, Optimization and Signal Processing (INCOS), Gurugram, India, pp. 194-199.
[4] "Real-time monitoring system for refrigeration using PIC microcontroller and LabVIEW" by R. Singh, S. Singh, and K. Singh, International Journal of Engineering Research & Technology, vol. 4, no. 5, pp. 252-255, 2015.
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[6] "Implementation of PIC Microcontroller Based Automatic Temperature Control for Refrigerator" by A. N. N. M. Fakhruddin and M. A. H. Akhand, Journal of Information Engineering and Applications, vol. 6, no. 6, pp. 14-21, 2016.