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**INDIVIDUAL ASSIGNMENT**

**TECHNOLOGY PARK MALAYSIA**

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**INTRODUCTION TO COMPUTER ARCHITECTURE AND NETWORK**

**UCFF2209CT**



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# **INTRODUCTION**

Refrigerators are an elementary component of global household work based on elementary and intriguing scientific concepts. The chosen communication feature in a smart refrigerator is the sensor system which is known as a smart sensor or a smart refrigerator sensor. This is a technology that designed for consumers as a sensor system for users to monitor and control diverse circumstances and situations in this embedded system. Refrigerator system controls are designed to automatically optimize the operating temperature, fan speeds, and pressure that demotes the system's energy consumption whilst maintaining the refrigerated spaces or equipment inside using the sensors.

After collecting data from the sensors, the central control unit can utilize that data to customize the settings in the refrigerator according to necessity, guaranteeing the unit operates systematically and degrade the optimum atmosphere for storing food. In certain circumstances, the control unit may also use sensor data to diagnose and address the problems with the refrigerator, notifying the consumer or an expert technician to mend if any issues emerge.

To summarize, to verify that the refrigerator maintains optimal temperature and runs smoothly preserving food and preventing spoilage, the central control unit cooperates with these sensors by communicating eloquently with the control unit to send out messages to alert the user to regulate the cooling system ensuring the nourishment inside stays fresh for a longer period and prevents detrimental bacteria reproduction.

# **CONTENT**

# **Networking Components**

# **Hardware**

Networking components for hardware in refrigerators is limited and are typically included in smart refrigerators that offer additional features and functionality beyond basic refrigeration. Hardware is the physical components of two or more computers that communicate data electronically, this equipment is used to connect refrigerators, devices, and networks simultaneously to allow communication and data transmission. The Internet connectivity allows communication with other smart devices by accessing online contents, obtaining software updates, and conversing with other smart gadgets by empowering network components. They enable users to monitor the refrigerator’s temperature, energy consumption, and other performance metrics remotely.

Temperature sensor transmits various other sensors and devices through the smart home network by examining using the wireless tool. This sensor aids in maintaining optimal conditions inside the refrigerator and distributes information to the high-technology refrigerator for adjustments and alerts if essential. There are several temperature sensors that provide temperature evaluation which assists a readable form throughout an electrical signal such as thermostats, thermistors, resistive temperature detectors, thermocouples, and negative temperature coefficient (NTC) thermistors. The basic working of this sensor is based on the voltage in the diode. The resistance of this diode is directly related to the temperature variation and is calculated using this sensor which evaluates the level of rise and decrease in temperature stages. This tool is identified and converted into straightforward and comprehensible temperature values for instance “Fahrenheit”, “Kelvin”, or “Centigrade”. A bimetallic strip or thermistor, and a wiring harness that integrates the sensor towards the thermostat control circuit is the containing of temperature sensing elements. The temperature sensors are located in various sections in the refrigerator to allocate better-detailed temperature scanning to secure the temperature and maintain consistency throughout the refrigerator’s compartments.

The gas sensors in a refrigerator is designed to evaluate the rank of gases based on the atmosphere's presence through the appliance, such as carbon dioxide (CO2) or Freon. The main motive of this system is to discover any leakage in the device cooling system which could result in safety hazards, for example, fire or explosion and to certify the genuine performance of this machine. There are several gas sensors that provide gas evaluation which assists a readable throughout and electrical signal like semiconductor gas sensors, infrared gas sensors, catalytic gas sensors, and electrochemical gas sensors. The most widely used type of gas sensor in a refrigerator is the semiconductor gas sensor where this sensor encounters a particular gas immersion and then utilizes a metal oxide or additional semiconductor material to identify changes in electrical conductivity. This sensor is located depending on the refrigerator’s model such sensors can be found in the compressor, evaporator, or separate compartments near the refrigerator lines or compressor. Gasses such as R-134a, carbon dioxide, and ammonia are sensitive to this sensor. The sensor transmits a sign to the control system to activate an alarm when a discharge is identified of hazardous gasses. This way the operation averts leakage from becoming unfavourable or resulting detrimental to humans or belongings. This semiconductor gas sensor is utilized in refrigerators to observe the status of the food stored within.

Diagram

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Types of temperature sensor 1

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Types of gas sensor 1

## **Protocols**

Networking components for protocols based on sensors in refrigerators are used for transmitting and obtaining data from the sensors instead of traditional networking objectives. These protocols are a list of guidelines or instruction to genuinely utilize the device which contributes various functionalities and to dependable communication to provide the consumer with more precise and timely information regarding the condition of their food and to ameliorate energy efficiency needs permit from smart refrigerators.

Analog protocols are a type of protocol that transmits the analog sign which is a continuous electrical signal that conveys information between sensors and the control system. There are two types of analog protocol which are voltage signal and current signal, these parameters are measured in temperature, humidity, or current. This protocol is widely used for temperature sensing that generates an analog voltage signal that differs with the temperature and the voltage sign which will then be amplified and get operated from an analog to digital converter (ADC) to acquire a digital portrayal of the numbers and ultimately will be utilized by the control system to regulate the cooling performance of the refrigerator. In addition, analog protocols are also used for numerous functions in refrigerators like current sensing for observing the performance of the compressor motor. In these circumstances, a current sensor constructs an analog signal that differs from the motor current which will after that be converted into a digital rate using an ADC for the procedure. In general, these analog protocols in smart refrigerators authorize the systematic and precise assessment of the temperature and other parameters by allowing exact control of the cooling system and energy saving.

Digital protocols communicate and send data among digital devices which send out signals in discrete and binary values which are represented as 0 and 1. Furthermore, this protocol is mostly used in high-technology refrigerators for the purpose to transmit data, controlling signals, and reporting system conditions. This protocol empowers rapid and systematic information transfer, accurate control of refrigerator system parameters, and exact observation of system status. Besides, this digital protocol can use remotely to monitor and control commercial refrigeration applications which are managed from a central control system for collective units. Inter-Integrated Circuit (I2C), Universal Asynchronous Receiver-Transmitter (UART), and Serial Peripheral Interface (SPI) are types of digital protocols. The I2C is a broadly used digital communication that is used to interface with sensors and various other components as it empowers multiple devices to communicate with one another using a two-wire serial interface similar to UART on displays and keypads where one is for data transmission and another for a reception that has a serial. I2C is uncomplicated to implement and handy for short-distance communication. Whereas SPI also communicates with other devices for instance sensors, actuators, and microcontroller howbeit utilizes a four-wire interface and supports a much higher speed data-transferring figure over a short distance compared to I2C. This protocol is universally used for communicating with temperature sensors and utilizes a master-slave architecture, in which a microcontroller or control system acts as the master and the sensors or other devices as slaves. The SPI is a more preferred communication protocol in contrast to other protocols for lower latency and superior reliability.

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Temperature protocol 1

Diagram

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Gas protocol 1

# **How it works**

The central control unit in a refrigerator commonly referred to as the main control board by controlling and coordinating the refrigerator's various functions such as regulating the temperature inside the refrigerator and freezer compartments. The control unit may include technologically advanced features that consist of energy-saving modes, electronics displaying temperature, and diagnostic to recognize and troubleshoot refrigerator issues.

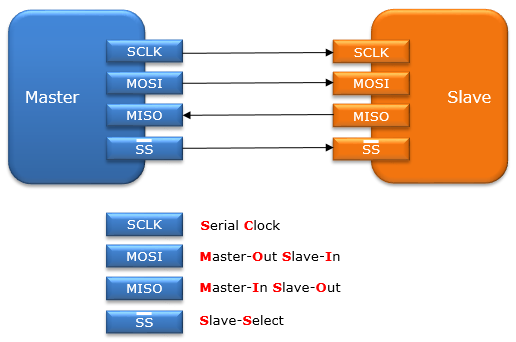
The thermostat sensor observes the temperature within the refrigerator and freezer cabinets by transferring information so that the thermostat or the refrigerator’s electronic control board can sustain the ideal temperature as client desires. The analog-to-digital converter (ADC) sensors located in the refrigerator compartments, control board, motherboard, or the panel at the back of a refrigerator depending on the model that translates voltage signals from the temperature sensor into a digital form signal so that it can process the thermostat microcontroller. The microcontroller functions as the brain in the thermostat that processes the digital signal from the ADC and compares it to the set point temperature that which user chooses. Presuming to switch on the heater or cooler if the temperature is low using the microcontroller is in comparison when the situation turns in contrast. Subsequently, to send a signal to the microcontroller will be obtained by the relay. This relay switches on or off when it receives a signal from the microcontroller to turn on the heating or cooling system whilst if the temperature is achieved at the user's preference point then the relay switches off. The final process is the feedback loop that guarantees that the temperature stays at a stable point. This sensor will consistently address temperature records to the microcontroller which then alters the heating and cooling system as required to set constant point temperature.

The semiconductor gas sensor generates analogs from a similar possible difference by altering the resistance of the substances within the sensor by calculating output voltage based on the concentration of the gas sensor. The control board, motherboard, or behind the control panel which is found back of a refrigerator is the location of the Serial Peripheral Interface (SPI). The communication of SPI consists of a master device and a slave device or more. The control system is the SPI master, and the gas sensor is the SPI slave in a refrigerator whereas the SPI bus is a set of wires that links the master as well as slave devices. The SPI bus consists of four wires which are Slave Select (SS), Serial Clock (SCLK), Master Out Slave In (MOSI), Master In Slave Out (MISO). The SS wire is used to select the gas sensor when the master wants to converse with the gas sensor by sending a signal on the SS wire to choose it. This sensor detects specific gases in the air that are harmful and most probably effect the safety of food for users to consume. The clock signal synchronizes the communication between master and slave devices, while the MOSI and MISO signal enables bidirectional data transfer. The master sends a signal on the MOSI wire and the slave will receive the data. When the master wants to read data from the gas sensor it addresses a request on the MISO wire and the response will be sent on the MISO wire. The gas sensor sends the detected gas concentration data to the control system using the SPI protocol. The control system receives the data and takes appropriate actions based on the gas concentration detected. Hence, the SPI protocol to interact with the control system is used by a semiconductor gas sensor by identifying gas concentration to the control system through the SPI bus. The received data will take applicable measures based on the concentration of gases discovered.

Diagram

Description automatically generated Timeline

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How does the temperature sensor works 1 How does gas sensor works 1 How does SPI bus works 1

# **Current Issues and Suggestions**

The most common issues that user most face is software bugs and security concerns. Smart refrigerators experience software bugs which effect complications with its functionalities such as temperature regulation and user interface. The temperature regulation relies on software to regulate temperature. As a result, if the software goes buggy, it impacts the temperature to fluctuate and leads to spoilage or frozen food. Moreover, these bugs cause malfunction or crash to the refrigerator. On the other hand, modern refrigerators have touchscreen or display panels which gives permission to collaborate with devices. If the system becomes faulty, this functionality becomes unresponsive or malfunctions.

Suggestions to overcome the security issues are to inspect if there are any available updates for updating the refrigerator’s software. An update that addresses the bugs the user is experiencing may have the manufacturer released an update therefore consumers are obligated to follow the instructions to update the software using the guidelines given which helps to recognize any vulnerabilities that are possible to be exploited by hackers. Moreover, the user can also try restarting the refrigerator by switching it off and unplugging it for a couple of minutes, and turning it back on to test if it works. In contrast to security bugs, the individual should change the default password which is easy to guess into a strong and unique password that only users know. Furthermore, users should be more cautious regarding personal information by avoiding storing sensitive data, such as credit card numbers or passwords in smart refrigerators and making certain it is well secured.

# **CONCLUSION**

Smart refrigerators represent a significant technological advancement in the household appliance industry by proposing a plethora of features not only user convenience but also saving time and energy. A smart refrigerator performs systematically and productively when the central control unit plays a vital role in guaranteeing by ensuring ideal temperatures and conditions for retaining the freshness and standard value of the food stored inside. With the assistance of sensors and protocols that aids the usage of refrigerators to be more beneficial for fulfilling consumer’s desires. Nonetheless, there are some drawbacks to owning a smart refrigerator that should be acknowledged by the industries that become a barrier and concerns in terms of usage such as privacy and security. Therefore, gaining loyalty from consumers is essential not only for security and privacy wise but also for giving out the best convenience and eco-friendly to the environment.

# **INDIVIDUAL REFLECTIONS**

Based on my research of smart refrigerators, I have extensively gain knowledge from educating myself in this particular topic, not only for understanding the basics of hardware and protocol but also making an initiative exploring for how this particular embedded system functions. My reflection from collaborating as a team and as individually allowed me to share and gain information that is distributed internally and externally from variety resources. From my observation of this system, I managed to identify areas for improvements and develop strategies for growth since this embedded system plays a crucial role in modern society. Since technology rapidly advancing, the embedded system will evolve complex and interconnected although the current technology proceeds to refine communication and reflection practices we guarantee that these systems will continuously improve citizen’s lives.

# **REFERENCES**

* 26 March 2023. Design of refrigeration control system for parallel refrigerator unit based on PLC. <https://www.researchgate.net/publication/356881827_Design_of_Refrigeration_Control_System_for_Parallel_Refrigerator_Unit_Based_on_PLC> .
* 4 December 2022. Types of refrigerator temperature and defrost sensors. <https://partsofamericallc.com/blogs/news/types-of-refrigerator-temperature-and-defrost-sensors> .Parts of America.

* 4 December 2022. Refrigerant Gas Sensors. <https://gaslab.com/blogs/articles/refrigerant-gas-sensors> .Gaslab.com.

* 27 October 2021. Introduction to gas sensors: Construction types and working. <https://components101.com/articles/introduction-to-gas-sensors-types-working-and-applications> . Components101.

* Sara Dellinger. 4 June 2020. How does a refrigerator compressor work?

<https://www.hunker.com/12000409/how-does-a-refrigerator-compressor-work> .hunker.

* 16 April 2009.Semiconductor+GAS+sensor+in+Refrigerator. <https://malaysia.images.search.yahoo.com/search/images;_ylt=Awrx.3d9XiBkZe8Jz3DjPwx.;_ylu=Y29sbwNzZzMEcG9zAzEEdnRpZAMEc2VjA3BpdnM-?p=semiconductor%2Bgas%2Bsensor%2Bin%2Brefrigerator&fr2=piv-web&type=E211MY1406G0&fr=mcafee-malaysia#id=33&iurl=https%3A%2F%2Fi.ytimg.com%2Fvi%2FSh77laJmiHY%2Fmaxresdefault.jpg&action=click> .
* 25 April 2020. The fridge - how it works. <https://www.danfoss.com/en/about-danfoss/our-businesses/cooling/the-fridge-how-it-works/> .Danfoss.