Raspberry Pi Based Data Acquisition System Using Wireless Communication

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***Abstract* - This paper proposes an advance for process management via a credit card sized single board computer called raspberry pi based multi parameter using wireless communication and microcontroller that measures and controls various parameters in an industry. The system comprises of a single master and multiple slaves with wireless mode of communication and a microcontroller system that can either operate on windows or Linux operating system. The various interesting features are field device communication via USB-OTG enabled Android devices. The objective of the project is monitoring industrial parameters such as water level, temperature, fire detection, gas detection through wireless communication using raspberry pi.**

***Index Terms* –RASPBERRY PI, GAS sensor, ZIGBEE, TEMPERATURE sensor, LEVEL sensor, FLAME/FIRE sensor**

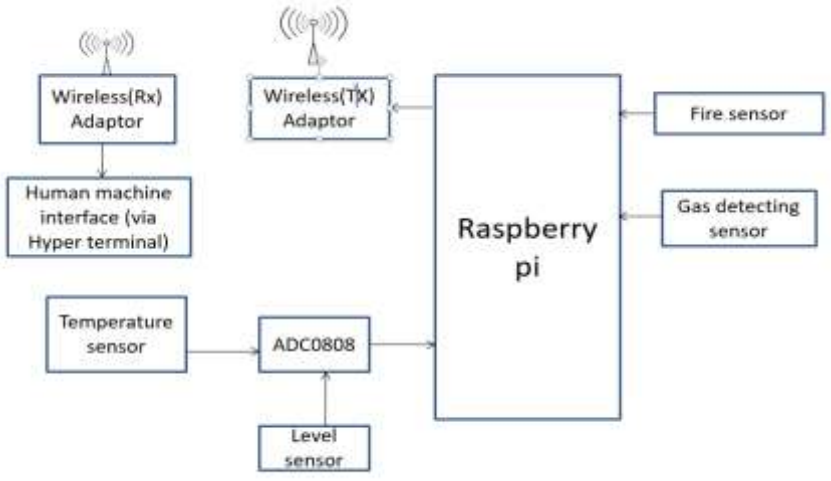
1.INTRODUCTION

Now a days the process monitoring in an industry plays a vital role. There are many ways to monitor each every process in an industry .but the main disadvantage is that they used wired communication as well as the equipments are very large and the maintenance is very difficult. but in our project we use credit card sized single board computer called raspberry pi to monitor each and very process in an industry. here the fire sensor and the gas sensor are the digital sensor were we can directly fed into the raspberry pi. where as the temperature sensor and the level sensor are the analog sensors. usually the raspberry pi is of digital form. hence the analog sensors are converted to digital form and fed into the raspberry pi.

We employ wireless communication in this project using zigbee transceiver. the zigbee transmitter transmits the data from the raspberry pi and its send to the zigbee receiver finally the datas of the receiver are obtained in personal computer.

Our project is of low cost as well as the which is easy to implement .our project has the highest accuracy compared to other industrial processing devices .since we using zigee it transmits and receives very quickly.

Block diagram



3.Hardware description

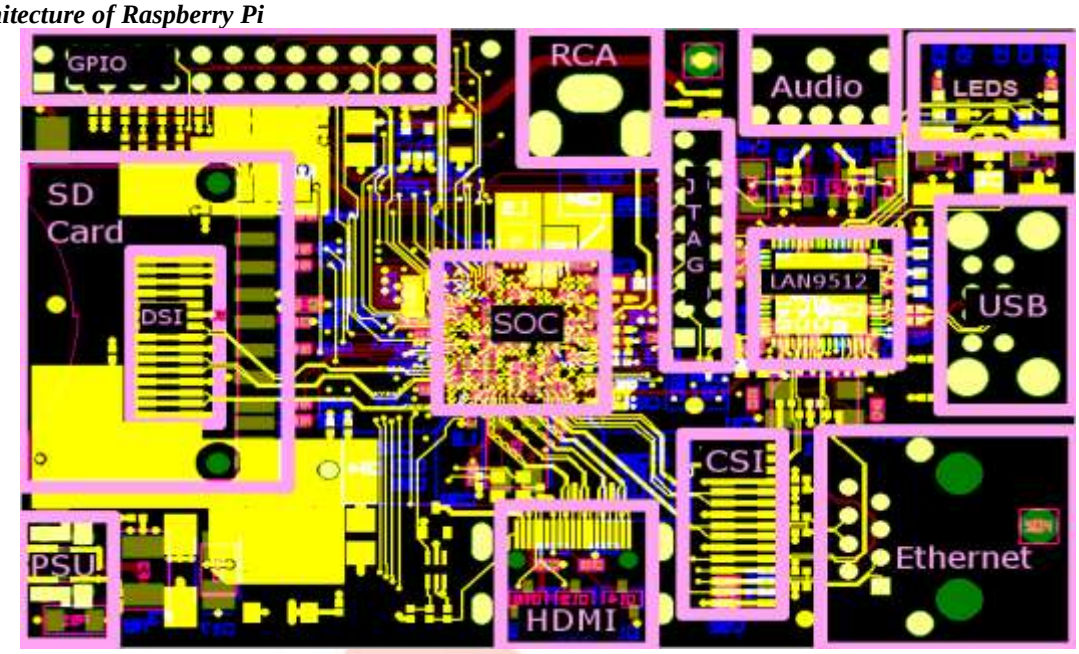
3.1Raspberry pi

overview

Raspberry Pi seems to be new in the world and many people really don't know what the Raspberry Pi is. Raspberry Pi can be defined as a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you would expect a desktop computer to do, from browsing the internet

and playing high definition video, to making spreadsheets, word-processing, and playing games. It is great bonding with Arduino and can do a lot with Arduino.

Internal Architecture of Raspberry Pi



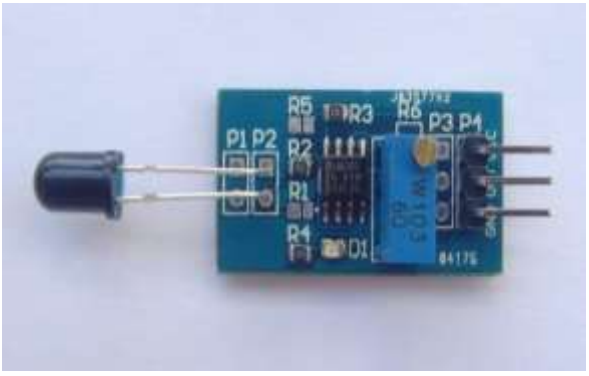
3.2 Gas sensor module

In current technology scenario, monitoring of gases produced is very important. From home appliances such as air conditioners to electric chimneys and safety systems at industries monitoring of gases is very crucial. **Gas sensors** are very important part of such systems. Small like a nose, gas sensors spontaneously react to the gas present, thus keeping the system updated about any alterations that occur in the concentration of molecules at gaseous state.

Gas sensors are available in wide specifications depending on the sensitivity levels, type of gas to be sensed, physical dimensions and numerous other factors. This Insight covers a **methane gas sensor** that can sense gases such as ammonia which might get produced from methane. When a gas interacts with this sensor, it is first ionized into its constituents and is then adsorbed by the sensing element. This adsorption creates a potential difference on the element which is conveyed to the processor unit through output pins in form of current. What is this sensing element? Is it kept in some chamber or is kept exposed? How does it get current and how it is taken out? Let's find out in this Insight!!!

3.3 FIRE/FLAME SENSOR MODULE

A key aspect of fire protection is to identify a developing fire emergency in a timely manner, and to alert the building's occupants and fire emergency organizations. This is the role of fire detection and alarm systems. Depending on the anticipated fire scenario, building and use type, number and type of occupants, and criticality of contents and mission, these systems can provide several main functions. First they provide a means to identify a developing fire through either manual or automatic methods and second, they alert building occupants to a fire condition and the need to evacuate. Another common function is the transmission of an alarm notification signal to the fire department or other emergency response organization. They may also shut down electrical, air handling equipment or special process operations, and they may be used to initiate automatic suppression systems.

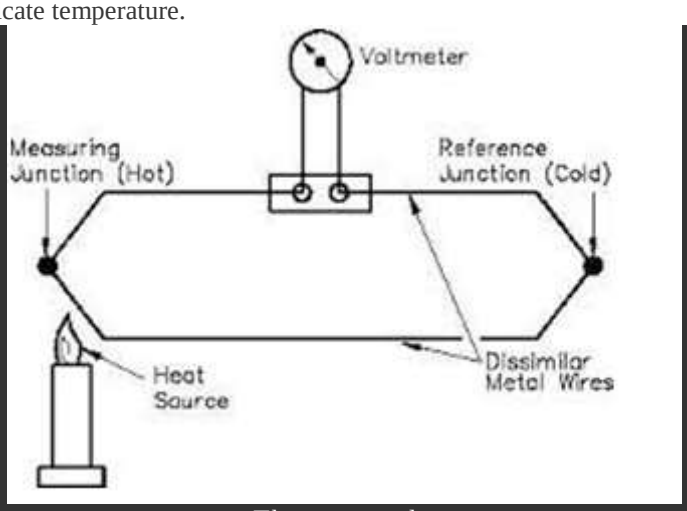


3.4 TEMPERATURE SENSOR

Temperature is the most often-measured environmental quantity. This might be expected since most physical, electronic, chemical, mechanical, and biological systems are affected by temperature. Certain chemical reactions, biological processes, and even electronic circuits perform best within limited temperature ranges. Temperature is one of the most commonly measured variables and it is therefore not surprising that there are many ways of sensing it. Temperature sensing can be done either through direct contact with the heating source, or remotely, without direct contact with the source using radiated energy instead. There are a wide variety of temperature sensors on the market today, including Thermocouples, Resistance Temperature Detectors (RTDs), Thermistors, Infrared, and Semiconductor Sensors.

3.5THERMOCOUPLE

It is a type of temperature sensor, which is made by joining two dissimilar metals at one end. The joined end is referred to as the HOT JUNCTION. The other end of these dissimilar metals is referred to as the COLD END or COLD JUNCTION. The cold junction is actually formed at the last point of thermocouple material. If there is a difference in temperature between the hot junction and cold junction, a small voltage is created. This voltage is referred to as an EMF (electro-motive force) and can be measured and in turn used to indicate temperature.



Thermocouple

The RTD is a temperature sensing device whose resistance changes with temperature. Typically built from platinum, though devices made from nickel or copper are not uncommon, RTDs can take many different shapes like wire wound, thin film. To measure the resistance across an RTD, apply a constant current, measure the resulting voltage, and determine the RTD resistance. RTDs exhibit fairly linear resistance to temperature curves over their operating regions, and any nonlinearity are highly predictable and repeatable. The PT100 RTD evaluation board uses surface mount RTD to measure temperature. An external 2, 3 or 4-wire PT100 can also be associated with measure temperature in remote areas. The RTDs are biased using a constant current source. So as to reduce self-heat due to power dissipation, the current magnitude is moderately low. The circuit shown in figure is the constant current source uses a reference voltage, one amplifier, and a PNP transistor.

Thermistors: Similar to the RTD, the thermistor is a temperature sensing device whose resistance changes with temperature. Thermistors, however, are made from semiconductor materials. Resistance is determined in the same manner as the RTD, but thermistors exhibit a highly nonlinear resistance vs. temperature curve. Thus, in the thermistors operating range we can see a large resistance change for a very small temperature change. This makes for a highly sensitive device, ideal for set-point applications.

Semiconductor sensors: They are classified into different types like Voltage output, Current output, Digital output, Resistance output silicon and Diode temperature sensors. Modern semiconductor temperature sensors offer high accuracy and high linearity over an operating range of about 55°C to +150°C. Internal amplifiers can scale the output to convenient values, such as 10mV/°C. They are also useful in cold-junction compensation circuits for wide temperature range thermocouples. A brief details about this type of temperature sensor are given below.

- Low self-heating,
- ±1/4˚C of typical nonlinearity

and also in test, measurement and communications. A digital temperature is a sensor, which provides 9-bit temperature readings. Digital temperature sensors offer excellent precise accuracy, these are designed to read from 0°C to 70°C and it is possible to achieve ±0.5°C accuracy. These sensors completely aligned with digital temperature readings in degree Celsius

3. 6LEVEL MEASUREMENT

In industry, liquids such as water, chemicals, and solvents are used in various processes. The amount of such liquid stored can be found by measuring level of the liquid in a container or vessel. The level affects not only the quantity delivered but also pressure and rate of flow in and out of the container Level sensors detect the level of substances like liquids, slurries, granular materials, and powders. The substance to be measured can be inside a container or can be in its natural form (e.g. a river or a lake). The level measurement can be either continuous or point values.

Quite obvious from its name, level sensors are used to measure the level of the free-flowing substances. Such substances include liquids like water, oil, slurries, etc as well as solids in granular/powder form (solids which can flow). These substances tend to get settled in the container tanks due to gravity and maintain their level in rest state. Level sensors measure their level against a pre-set reference.

In short, level sensors are one of the very important sensors and play very important role in variety of consumer/ industrial applications. As with other type of sensors, level sensors are available or can be designed using variety of sensing principles. Selection of an appropriate type of sensor suiting to the application requirement is very important.

Continuous level sensors measure the level to determine the exact amount of substance in a continuous manner.

Point-level sensors indicate whether the substance is above or below the sensing point. This is essential to avoid overflow or emptying of tanks and to protect pumps from dry run.

4.RESULTS AND CONCLUSIONS

Results

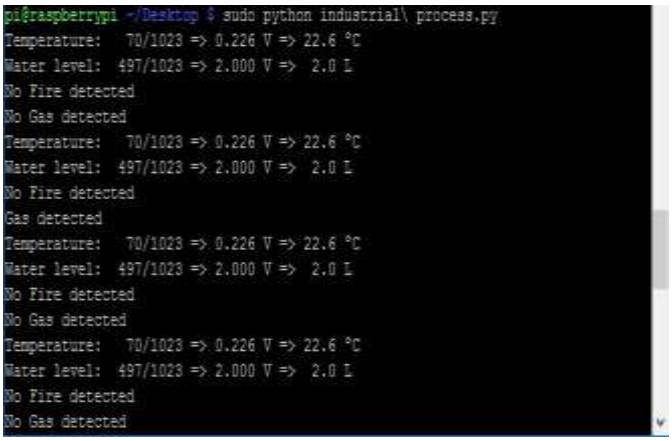
To design multi parameter monitoring system using Microcontroller that measures and controls various global parameters and the system comprises with wireless mode of communication. These process were managed using microcontroller. The parameters that can be tracked are Gas, temperature, light intensity and water level.

The system comprises of a single master and multiple slaves with wireless mode of communication and a microcontroller system that can either operate on windows or Linux operating system. Microcontroller can sends data to the other system using wireless communication.

The various interesting features are field device communication via USB-OTG enabled Android devices. Process Control and Monitoring system is developed to monitor the process value and control the values on needed without human interface.

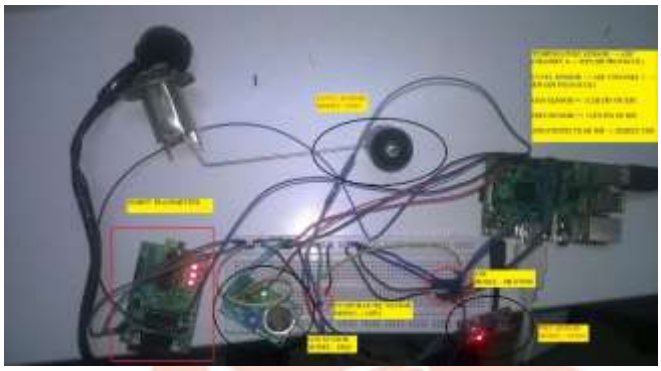
Thus, it can be defined as a mechanism removing as much human interaction as technically possible and desirable in various domestic processes and replacing them with programmed electronic systems. For the development of such design of raspberry pi industrial process monitoring system, Raspberry Pi is used as the main node which is used for both monitoring and controlling purposes. The main controlling and manipulating device can be taken as the Raspberry Pi as all the logical and mathematical tasks are perform in it. The monitoring application as well as the controlling application is developed in Raspberry Pi as it is the only computer in the system to do the tasks. The laptop in the system is just to monitor the website developed in Raspberry Pi through network.

Output Result



Raspberry pi based industrial process monitoring output

Hardware Setup



Hardware setup

CONCLUSION

Monitoring industrial parameters such as water level, temperature, fire detection, gas detection through wireless communication using raspberry pi are monitored successfully. The system can be enhanced for wave form representation of data in an excel sheet using raspberry pi. The additional slaves can be added for measures various other parameters. Also controlling action can be set for some predefined cases in the master module which enables the automatic operation at certain cases. A dedicated video processor can be used in raspberry pi to display graphical and three dimensional view of the industry. ZigBee with its excellent low-power capability provides an excellent alternative for Bluetooth . Support for ZigBee is currently being added and will be reported separately. This project having features such as Remote monitoring Wireless communication Easy to implement, High efficiency. Multi parameter monitoring system using Microcontroller that measured and controlled various global parameters and the system comprises with wireless mode of communication. These processes were managed using microcontroller. The parameters that can be tracked are Gas, temperature, light intensity and water level. The system comprises of a single master and multiple slaves with wireless mode of communication and a microcontroller system that can either operate on windows or Linux operating system. Microcontroller can sends data to the other system using wireless communication.

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