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Raspberry Pi Based Industrial Process Monitoring and Control through Internet of Things

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Abstract: The objective of this project is to monitor the industrial process automatically. This is in need to reduce the manpower and it is a 'cherry to the cake' of technology. The main aim is to develop a system which will automatically monitor the industrial applications and generate alerts/alarms or take by the intelligent decision raspberry pi microcontroller Model 3 B using the basic concept of IoT and also design the system to take intelligent decision and control devices automatically without man intervention. Here on industrial automation has become very much popular nowadays. We tend to measure the basic temperature humidity and vibration and metal detection in a sensor for processing the industrial automation.

Keywords: raspberry pi, temperature sensor, humidity sensor, pressure sensor, proximity sensor, IoT web shield.

I. Introduction:

As, the world is getting more technologically forward locking we find more new technology coming deeper into our personal and professional lives. Nowadays the society in the daily endeavors has become so dependent on automation. It is more difficult to imagine life without such automation engineering in current environment. The system deals with addition to the industrial production with which is popularly associated. Now it covers a number of unexpected areas in system research. The approach to wireless network for industrial applications standardized nowadays. Intelligent and low-cost automation of industrial process are crucial in order to improve process efficiencies deliver quality products and ensure timeliness and accuracy of systems.

II. Objectives and scope of the project:

Nowadays, the industries require more manual power to monitor and control the parameters like pressure, temperature, vibration, water level, humidity, etc…with the help of raspberry pi microcontrollers and LCD displays in various locations.

Here, the sensing equipments are used to sense the various parameters. In casa the parameters will not be monitored and controlled properly at the time of emergency, it leads to a harmful situation. So the method of monitoring the overall parameters through a single computer and a concept of automatic control will reduce the high manpower equipment. In this method the industrial parameters like pressure temperature, humidity, water level, and vibration are sensed by the respective sensors and are monitored by the raspberry-pi microcontroller. Then, the values are displayed by using the raspberry-pi microcontroller displays in the respective locations. Finally, the overall parameters values are monitored by raspberry-pi microcontroller by using IoT application and its can also control the parameters automatically. The general objective of this project is to design the monitoring and control system of industrial parameters using raspberry-pi microcontroller by using IoT application. This project is used to reduce the high manpower requirement in industries by monitoring the overall parameters through a single Raspberry-pi microcontroller with the help of Iot and also controls the parameters without any manual operation. Basically, this project is designed with microcontrollers and various sensors such as pressure sensor, temperature sensor, and metal detection sensor, humidity sensor, vibration sensor, and level sensor. Additionally, this system has an Ethernet facility with interface and controller to transmit data from microcontroller to Internet of Things and seen the parameters worldwide. The industrial monitoring and control is a combination of architectures, mechanisms, and algorithms used in the industrial factory for monitoring and control the activities of industrial processes controlled motors machines and devices employed in industry premises to achieve the goal.

Though it sounds good enough to have a smart industrial environment in the near future but it will also have a smart industrial environment in the near future but it will also have to face hurdles of handling big data as all the devices will communicate with each other and exchange their information over a common-platform. The present project is focused on industrial applications that will be continuously monitored through a set of sensors that constitute a sensor module. The sensor module collects the relevant data to determine whether the

applications to be monitored are working well under certain threshold values. The data from various sensors in the sensor module is fed to the controlling device basically a raspberry-pi microcontroller. This controlling device is interfaced with an IoT through Ethernet to get accessed remotely by users. The controlling device simultaneously forwards data to the main server.

The main server located at the industry premises displays the corresponding data received from the controlling device. An arrangement of accessing the main server remotely by mobile users can be achieved through TCP/IP protocol, thus monitoring of the application can be done through remote access. If the industrial applications seem not to be working properly after being monitored then they can be controlled remotely by mobile users through accessing the controller by means of GPRS enabled GSM module. GPRS communication offers a non-stop, secure and cheap communication to individuals where there is no access to internet. Thus, industrial applications will be precisely monitored and controlled by means of GPRS communication. Hence, the workers in the industry will be saved from the harmful situations. Hence, the workers in the industry will be saved from the harmful situations.

III. Block Diagram:

The basic block diagram is given as follows….

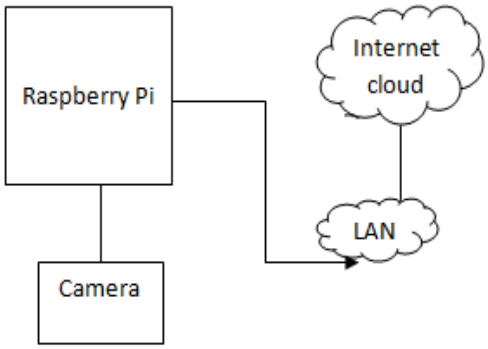

Fig: 1.1 basic block diagram.

IV. Hardware Description:

To implement the process monitoring and control in industry we would like to go in for Raspberry-pi microcontroller as a central core of the project. Also with microcontroller using of IoT applications we will be monitoring and control the industrial parameters anywhere at any places.

V. Exploring the raspberry pi:

There are two models of raspberry Pi, model A and model B. these two is bit similar with few advance features on model A and model B has 512 MB RAM, two USB port where as model A has 256 MB RAM and just a USB port. Besides, Model B has Ethernet port while Model a does not. The overview of the raspberry Pi Model B is shown below.

Fig1.2 Exploring the Raspberry Pi

SD card slot:

Raspberry pi doesn't have the real hard drive as in laptop and computer, SD card is taken as solid drive (SSD) which is used to install operating system and all others software and store everything. This card is needed to insert into the slot for using the raspberry pi. SD card may be 2GB, 4GB or 16GB.

Micro USB Power:

The power port is a 5V micro- usb input and supply should exactly 5V as it doesn`t have onboard power regulator. So Power supply shouldn't exceed than 5V.

HDMI out:

This output port is used to connect the raspberry Pi with a monitor via HDMI (high definition multimedia interface). Hence, any screen or TV can be connected to it which consists of HDMI port.

Ethernet and USB port:

Both the Ethernet port and USB port on model B are supplied via the onboard LAN9512 chip. It is a high- speed USB 2.0 hub with a 10/100 Ethernet controller. USB ports are jacks to be plugged in headphones but USM mikes may work or not. For video, the RCA jack sends video to any connected RCA video devices.

GPIO Headers pin:

GPIO pins stands for general purpose of input output pins. These pins are used to connect any number of physical extensions with the raspberry pi. Raspberry pi has pre-installed libraries that allow us to access the pins using programming languages like c, c++ and python.

Raspberry pi 3 model B:

Recently, raspberry pi 3 model B has been launched recently which Broadcom BCM2836 ARM cortex-A7 Quad core Processor has powered single Board computer running at 900Mhz, 1GB RAM and 4 quad USB ports. It is the advanced version of model B and is 6 times faster than model B and 6 times faster than model B raspberry pi. In addition, it has combined 4-pole jack for connecting your stereo audio out and composite video out and advanced power management.

Hardware required for raspberry pi:

Raspberry pi can't start alone, it needs many others peripherals (hardware). There is brief description of the hardware of requirements in the following section bates, 2014.

Power supply:

As mentioned already in above theory portion, raspberry pi needs 5V then it can't guarantee to work properly. And the power supply also need to supply at least 500 milliamps (mA), and preferably more like 1 amp (A). If the supply is 500mA or less, it is likely to have the malfunction of keyboard and mouse. It is not good idea to power the raspberry pi from USB port of computer and hub as they mostly provide current less than required. Hence, the raspberry pi requires a micro-usb connection which is capable of supplying at least 700mA (or 0.7A) at 5V.

Monitor:

We can use monitor or TV with HDMI port or DVI inputs as the screen for the raspberry pi. For DVI inputs, HDMI to DVI converters are required which can be finding easily in a market. Monitor is most important for the raspberry pi as it is the only way to see what we have done on it.

Network:

As, in laptop or computer, we can access to internet and network in raspberry pi as well. For, that we can use wired Ethernet connection this is easier option or Wi-Fi module to access Wi-Fi in the raspberry pi.

Internet of Things:

From any time, any place connectivity for anyone, we will now have connection for anything in the world. The IoT refers to the connection of devices to the internet. And as the internet of things grows in the next few years, more devices will join this list.

Temperature sensor:

Fig1.3 Lm358 temperature sensor

The temperature sensor LM35 series are precession temperature sensors. Its output voltage is directly proportional to the Celsius temperature. Therefore LM35 has an advantage over linear temperature sensors calibrated in ^{o} Kelvin, as the user does not need to subtract a large constant voltage from its output to obtain suitable centigrade scaling. It can be minus power supplies. It sinks only 60uA from its supply; it has less self-heating, less than 0.1 ^{o} c in still air. The LM35 is rated to operate over a range of -55 to +150 ^{o} c temperature.

Humidity sensor:

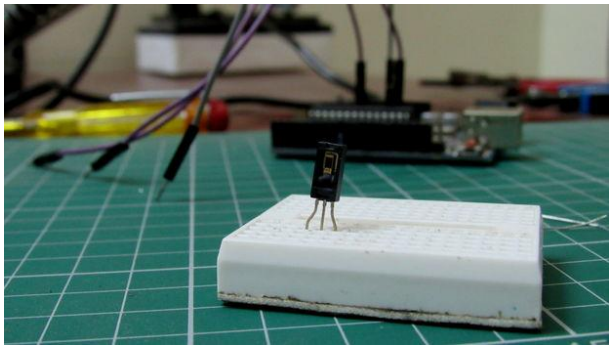

Fig1.5 Humidity sensor HIH4000

The humidity sensor HIH4000/HSY220 is developed by Honeywell. It is used for detecting the humidity. It delivers high quality RH (relative humidity) sensing performance at a cheap price. It is soldering able SIP (single inline package). Its relative humidity is a measured, in percentage. This sensor output voltage simply follows its supply voltages increases, and vice versa. It generally operates in the range of 4-5.8 supply voltage. For example the output voltage varies from 0.8to 3.9v at room temperature, as the humidity varies from 0% to 100%. The resolution of humidity sensor is up to 0.5% of relative humidity (RH). As its current draw capacity is only 200 uA, this sensor series is suited for low drain, battery operated systems. Output voltages of these sensors changes in proportion with the changes in the surrounding RH. The output voltage of these sensors is proportional to the supply voltage. Therefore to convert this into RH from we need to consider both supply voltage and sensors output voltage. This conversion can be done by using following formula.
RH= ((vout/vsupply)/0.0062, typical at 25^{o}c.

Proximity sensor:

Fig 1.6 Proximity sensor

A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact. A proximity sensor often emits an electromagnetic field or beam of electromagnetic radiation and looks for changes in the field or return signal. The electromagnetic radiation and looks for changes in the field or return signal.

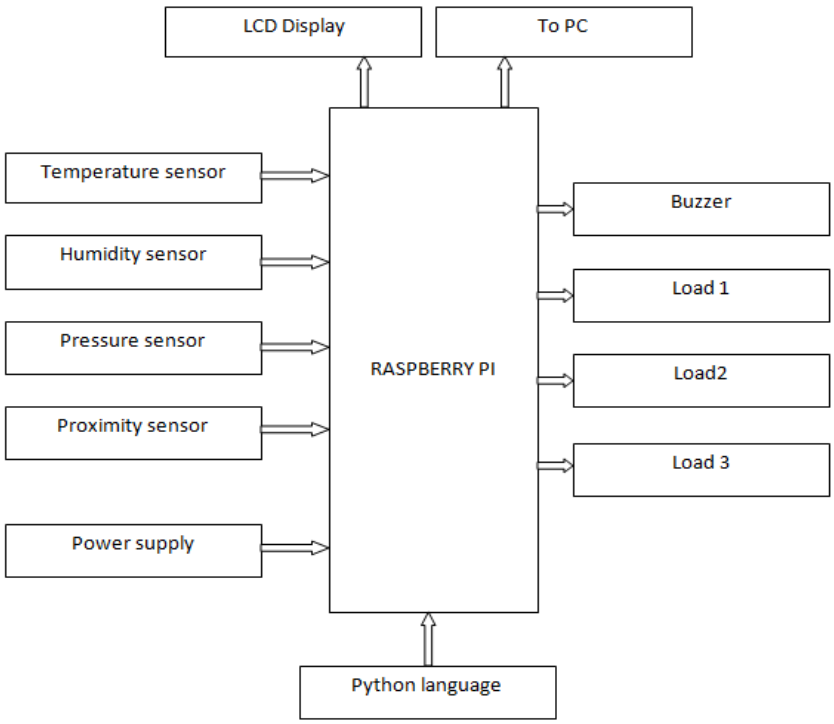

Fig.1.7 Block diagram

Pressure sensor:

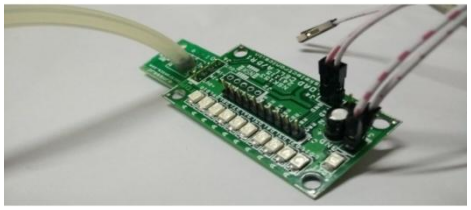

Fig 1.8 Pressure sensor

The pressure sensor is mainly used in the calculation of the industrial pressure such as the lightning, thunderstorm, and any other pressure such as the lightning, thunderstorm, and any other pressure.

Buzzer:

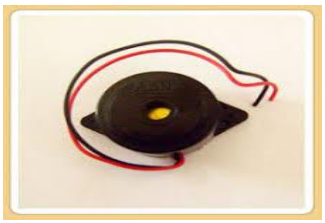

Fig1.9 buzzer

Buzzers are typically used in timers, alarming devices, and for confirmation of user input such as a keystroke or mouse click. It most generally comprises of various switches or sensors associated with a control unit that figures out whether and which switch was pushed or a preset time has slipped by, and for the most part enlightens a light on the fitting catch or control board, and sounds a notice as a nonstop or irregular humming or beeping sound. At first this device depended on an electromechanical framework which was indistinguishable to an electric bell without the metal gong which makes the ringing commotion.

VI. Working principle:

For the control process, this system has solenoid valve, heater, pump which controls the pressure, temperature and proximity. The control process will automatically take place, only if the parameter exceeds the fixed value. For an instance, the pressure is sensed by the diaphragm, a type of transducer in the pressure is sensed by the diaphragm, a type of transducer in the pressure sensor circuit.

The sensed data is then amplified by the operational amplifiers sensor circuits. Here, the raspberry microcontroller with IoT performs various operations like converting the received analog signals into digital values with the help of in- built ADC converter, storing the data with the help of in-built ADC converter, storing the data with the help of FLASH memory, etc… to monitor the sensed values through a LCD display connected with the microcontroller.

VII. Conclusion:

This project describes a smart interface sensor interface for industrial WSN in IoT environment. The system can collect identification information of sensor gently. Its design based on raspberry-pi microcontroller by combining IoT and the application of wireless communication. It is very suitable for real-time performance and effective requirements of the high-speed data acquisition system in IoT environment. The application of raspberry-pi microcontroller simplifies the design of peripheral circuit and it also provides parallel processing of data collection. Raspberry-pi microcontroller also makes the whole system more flexible and it expand the range of applications in Iot for the sensor interface device. Application of raspberry-pi microcontroller enables the system to collect sensor data intelligently. By using these devices, information of different types of sensors can be connected to the system without any complicated program.

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