

Wireless Industrial Automation System

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Abstract

This paper highlights the design and implementation of Raspberry Pi based wireless industrial automation system using PYTHON. The system consists of one module that is Sensor module. The sensor module is the raspberry pi for monitoring and controlling the various parameters of an industrial plant. The coordinator module is implemented using the raspberry pi that is with sensor module. The raspberry pi is used at the sensor module and they are programmed using python. The experimental results obtained demonstrate the usefulness of the proposed system in terms of the low power consumption. It is off low cost and targeted towards automation and remote control applications.

Keywords: Python, Industrial Robot, Raspberry Pi, Wireless Technology, Industrial Automation.

1. Introduction

All the things used in automation system are advanced sensing technology, control technology and mechanics technology with industrial robots. The survey of the recent work in the area by specifically examining the forms of cooperation and coordination realized in the Multi Robot Systems was represented in [1]. The robot manufacturers make great efforts to user-friendly teach pendants, implementing ergonomic design concepts, more intuitive user interfaces such as icon based programming was represented in [2]. A humanoid learns referee signals by pairing kinesthetic teachings with human teacher executions and it was recorded to the wearable motion sensors as presented in [3]. The reference [4] presented an assortment of case studies and the explanation about how the arc-flash hazards are identified, measured and mitigated in various industrial processing facilities. Programming robot behaviors in Pyro is akin to programming in a high-level general purpose programming languages; Pyro means Python Robotics. Pyro provides abstractions for low-level robot specific features much like the abstractions provided in high-level programming languages was represented in [5]. The reference [6] represented the teach pendants are not intuitive to use and require a lot of user experience, besides being big and heavy. The hybrid force

or position control approach is proposed for trajectory control of robot manipulator, which works well in the absence of anonymous dynamics of a robot manipulator in a constraint environment was presented in [7]. The robotic system allows the users to instruct and program the robot with a high level abstraction from robot language. It offers the practical method to program robots by the means of gestures and speech, improving the work efficiency and saving time, It presents an alternative to the typical robot teaching process extending the concept of human-robot interaction was represented in [8]. The reference [9] presented to unravel the nonlinear control snag integrated the fuzzy gain scheduling method with a fuzzy proportional, integral and derivative control for industrial robot manipulator. The linear prediction with a lightweight type robot, capable of both subtractive and additive manufacturing will have an impact on car industry and small and medium sized enterprises were represented in [10]. The reference [11] presents a systematic survey and analysis of the existing literature on coordination, especially in multiple mobile robot systems.

1.1 Mathematical background

In this industrial monitoring system the only mathematical equation used here to find the obstacles in the path by the ultrasonic sensor, it shows below.

$$\text{Test distance} = (\text{High level time} \times \text{Velocity of sound (340M/S)}) / 2$$

Using above formula we can detect the obstacles present from short distance to very long distance. The sensor is high sensitive to obstacles in the path. The digital sensor that senses the obstacles with their ultrasonic waves so in any range of obstacles can be detected easily through this sensor. It represents the distance measurement of obstacle in another way also it is described below.

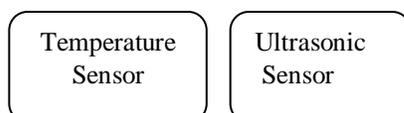
$$L = C \times T, \text{ Where } L = \text{Measured Distance, } C = \text{Spreading Velocity of Obstacle, } T = \text{Time.}$$

Using this mathematical formula also we can find the distance of the obstacle from the system using ultrasonic sensor. Here in this project the Ultrasonic Sensor detects the obstacles between 50 Centimeters to 100 Centimeters below that it will not detect because it is programmed in the processor like that with Python.

2. Methology Proposed

Figure 1 illustrates the block diagram of proposed methodology. In this block diagram of the industrial monitoring system consists of many main blocks, They are Temperature Sensor, Gas Sensor, Ultrasonic Sensor, Raspberry PI, DC Motors, USB Camera, Wifi Dongle, Buzzer, Cooling Fan, Power Supply. All the blocks are described below. Ultrasonic sensor provides an easy method of distance measurement. This sensor is perfect for any number of applications that require you to perform measurements between moving or stationary objects.

The block diagram of Industrial Automation System is shown below.



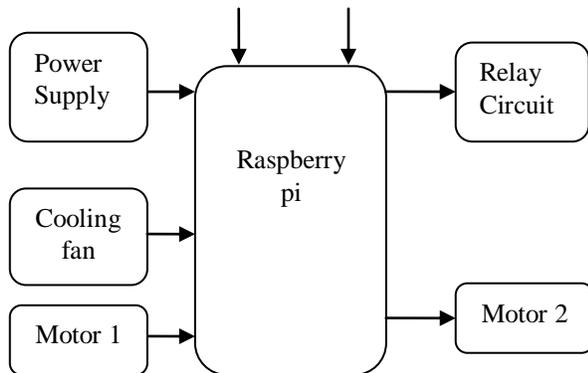


Fig.1 Block Diagram for Proposed methodology

2.1 Block Description

The Digital Temperature Sensor used in this project to monitor and control the rising machine temperature, room temperature in the industry. Power Supply range is 3.0V to 5.5V. It measures temperature from -55°C to $+125^{\circ}\text{C}$. It requires no external components, $\pm 0.5^{\circ}\text{C}$ accuracy from -10°C to $+85^{\circ}\text{C}$.

The Digital UltraSonic Sensor is used in this project to detect the obstacles by the robot travelling through path of the industry, Here it detects the obstacles distance of 50 Centimeters below it will not detect because it is program like that in the processor. Ultrasonic sensor provides an easy method of distance measurement. This sensor is perfect for any number of applications that require you to perform measurements between moving or stationary objects.

RASPBERRY PI2 is used as main processor in this wireless industrial robot to make the robot to work with very much ease and precised manner, it controls and monitors all the parameters in the industrial plant. All the robotic functions are controlled by Raspberry Pi processor, through this processor we can do any modifications in robot with software program, the program is used in this processor to control the robot is mainly PYTHON.

The DC MOTOR used in this industrial monitoring system. It is very much important for movement automatically while any obstacle in the path as well as full movement of robot is controlled in the wheel because of the two motors. The dc motors are connected to the wheels of the robot to make the movement easier through any path. The COOLING FAN used in this project is about DC Fan. When the Machine Temperature, Room Temperature increases suddenly this detects the sensor and it gives indication to the relay according to that fan rotates till the temperatures comes to normal level, then only the fan stops. When the hazardous gases present in the industry means this also detects by the sensor and give indication to relay according to that fan rotates to decrease the gas level, the gas presence will be not in the industry means the fan will not rotates. The 12V DC power supply is used to perform the wheel movement of the robot using DC Motors. This power supply is also used to work the Fan and Buzzer, The sensors and the processor uses 5V DC Power supply to perform the operations.

3. Morphological operation

Morphological operation of ultrasonic sensor is to sense obstacles in the industry in any range. The temperature sensor monitors and controls the rising temperature of machine as well as room in the industry. The movement of robot is automatic. The morphological operations explain all the functions related to this project. The morphological operation consists of Circuit Diagram, Project Operation and it is described below.

3.1 Circuit Diagram

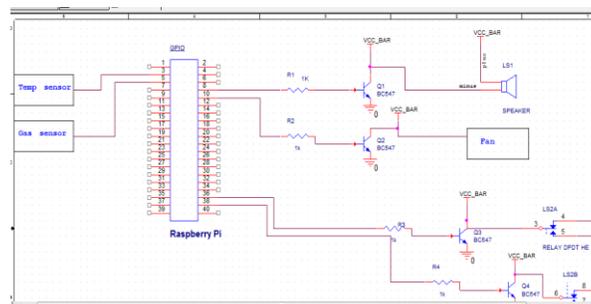


Fig. 2 Circuit Diagram of Industrial System

The circuit diagram of industrial robot is shown above, the diagram is drawn through QCAD software. QCAD is a free computer-aided design (CAD) software application for 2D design and drafting. It is available for Linux, Apple, OS X, UNIX and Microsoft Windows. The QCAD GUI is based on the Qt framework. QCAD is released under the GNU General Public License Precompiled packages are available for 32-bit and 64-bit GNU/Linux platforms, MS Windows OS and OS X. QCAD is developed by RibbonSoft.

3.2 Project Explanation

Much fast than any other processors. Circuit complexity is very less, Time consumption to work all the function is very much less and Program complexity in the processor is very much ease in this Raspberry Pi processor than any other processors. Here shows the robotic section it consists of Raspberry Pi Processor, Temperature Sensor, UltraSonic Sensor, Cooling Fan, DC Motors, Relay Circuit and Power Supply.

3. Practical Tests and Result

The experimental results includes all the comparison of

Temperature Sensor	Ultrasonic Sensor	Output Power
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0 – 35 ⁰ Cs	0–50CMs	0V DC
35 – 125 ⁰ Cs	50–100CMs	5V DC

3.1 Temperature Sensor

When the Temperature of Machine as well as Room Level in the industry below 35⁰C means the sensor will not give any response to relay so the fan will not rotate that time the total output voltage will be 0Volt. When the temperature of machine as well as room reaches to 35⁰C means the temperature sensor detects this condition and the cooling fan starts to rotate till the temperature go below this level. The total output power used by the sensor is about 5Volt for sensing action and for not sensing process it uses 0Volt. When the temperature of machine and room goes beyond 35⁰C means the temperature sensor detects this condition and cooling fan starts to rotate till the temperatures goes to below this level and the total output power is about 5Volt. The below graph shows the temperature sensor values, The X-AXIS shows the OUTPUT VOLTAGE used by the sensor and the Y-AXIS

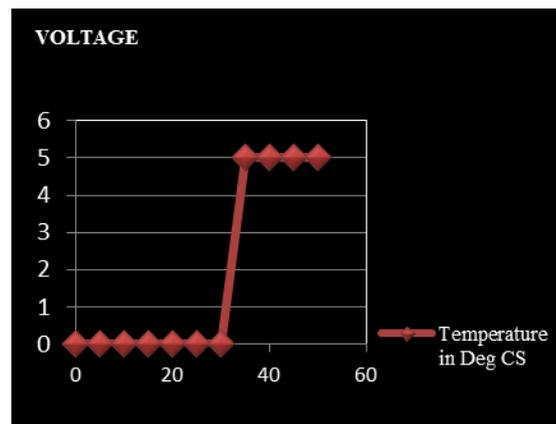


Fig. 4 Temperature Sensor Graph Values for Wireless Industrial Automation System

3.2 UltraSonic Sensor

The Digital Ultrasonic Sensor detects the obstacles in the industrial path of distance between 50cm to 100cm. The sensor will not detects below 50cm it is programmed like that, the sensor uses 5Volt power supply for sensing and for not sensing process it uses 0volt. When the obstacles present in the path means due to sensor

detection the robot deflect from that obstacle path and it travels along the path that will not have any obstacles.

According to this formula the distance of the obstacle is calculated $\text{Test Distance} = (\text{High Level Time X Ultrasonic Velocity in Air}) / 2$. The resultant ultrasonic sensor graph is shown below, the X-AXIS shows the OUTPUT VOLTAGE used by the sensor and the Y-AXIS shows the DISTANCE of the Obstacle detects by the

sensor in Centi Meters.

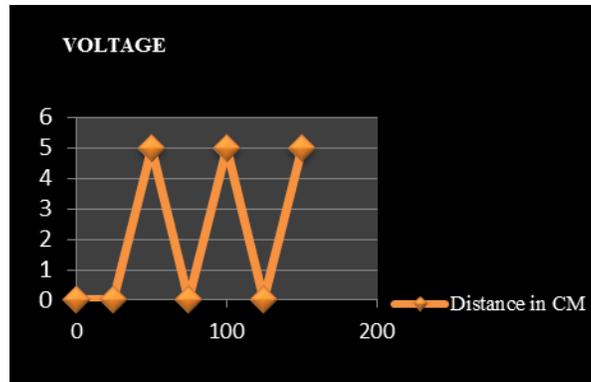


Fig. 5 UltraSonic Sensor Graph Values for Wireless Industrial Automation System.

5. Conclusion

We presented this paper has introduced the concept of a system in which industrial robots were applied to monitor and control the various industrial parameters like Machine Temperature, Obstacle Detection in the path of the industry and total movement of robot happens Automatically. The Sensor module means Raspberry Pi is used for monitoring and controlling the various parameters of industrial plant. The sensor programmed using Python. The experimental results obtained demonstrate the usefulness of the proposed system in terms of the low power consumption. It is off low cost and targeted towards automation and remote control.

Machine temperature is sensed by temperature sensor and controlled by the robot is very much ease. Obstacle detection is also sensed by ultrasonic sensor with in very less time as well as total function of the robot happens in very much less time.

Automatic movement of the robot towards any path done in very controlled manner and all the processor functions in the robot happens with very much precised manner. It targeted towards low cost, applications no labours needed, circuit complexity is very much less, no program complexity, area of space needed is very small, high reliability all these are advantages of this industrial robot.

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