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Application of Raspberry Pi in IOT Industrial Automation

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ABSTRACT

This page explores the concept of the Internet of Things (IoT), industrial automation using IoT, and the application of Raspberry Pi. In recent years, IoT has emerged as a key enabler for next-generation automation across various industries. It facilitates the interconnection of devices—ranging from wearable tech and smart meters to environmental sensors—through the internet. In this context, industrial devices and their parameters can be remotely monitored and controlled using IoT integrated with Raspberry Pi. The Raspberry Pi acts both as a computer and a server, with programming primarily done in Python. Being a compact and cost-effective computing platform, it supports a wide range of automation applications. This project presents an efficient industrial automation system that enables users to manage and control industrial equipment remotely via the internet.

Keywords – Industrial Automation, Internet of Things, Raspberry pi

I. INTRODUCTION

The Industrial Internet of Things (IIoT) is a rapidly emerging technology that is transforming the way industries operate. It involves the use of sensors to continuously monitor industrial equipment, a task that is often difficult or impossible for humans to manage manually. Traditionally, most internet-connected devices—such as computers and smartphones—have supported human-to-human communication. However, with the advancement of IoT, the future lies in device-to-device communication, where various electronic devices interact and exchange data autonomously. The term "Internet of Things" was first introduced by Kevin Ashton in 1998, describing a system in which the digital and physical worlds are seamlessly connected to form a global network. IoT not only enables access to information from anywhere, at any time, by any user, but also allows for real-time monitoring and control of devices from remote locations through secure networks. This transformative capability marks the foundation of modern industrial automation.

The concept of IoT aims in making Internet more ubiquitous and immersive. Thus accelerating the internet to make it enable by any authorized person for easy access and to have an interaction with enormous variety of devices for instance, home gadgets, spying cameras, monitoring sensors, actuators, automobiles, displays, and so on, the IoT will nurture the development of a number of applications that make use of the virtually enormous amount and variety of data generated by Things to provide new benefits to citizens, industry, and government sectors.

And Industrial automation is the use of control systems, such as computers or robots, and information technologies for handling different processes and machineries in an industry to replace a human being. It is the second step beyond mechanization in the scope of industrialization.

Automation is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and heat treating ovens, switching in telephone networks, steering and stabilization of ships, aircraft and other applications with minimal or reduced human intervention.

In this project we propose efficient industry automation system that allows user to efficiently control industry appliances/ machines over the internet. We are also using Different sensor (Temperature sensor, Humidity Sensor, camera, Gas Sensor) to monitor industry appliances with the help of smartphones.

II. METHODLOGY

1. OVERVIEW

In this project, the Raspberry Pi single-board computer functions as the primary device controller. It establishes communication with a remote IoT server using standard IoT protocols over a WiFi connection. A power supply circuit provides 5V DC to both the Raspberry Pi and the connected LCD display.

The Raspberry Pi features built-in WiFi, USB, and audio/video ports, and operates on Raspbian OS—a Linux-based operating system. Programming for the controller is done using Python, enabling flexible and efficient handling of hardware components.

Four relays are connected to the output pins of the Raspberry Pi, each controlling a separate industrial device. Additionally, four different sensors are connected to the Raspberry Pi to collect real-time data. Through its built-in WiFi module, the Raspberry Pi communicates with the cloud-based IoT platform. User commands issued through the platform are sent over the network to the Raspberry Pi, which processes them and activates or deactivates the relays accordingly.

An LCD is also interfaced with the Raspberry Pi to display the status of connected devices and provide real-time feedback or system messages.

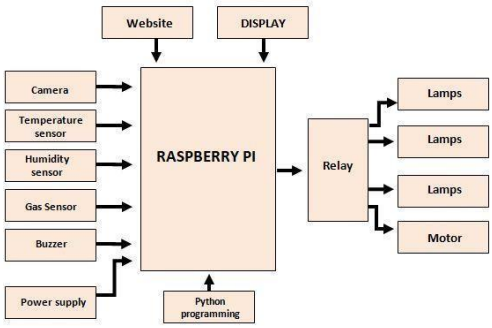


Figure - 1: Block Diagram

2. HARDWARE USED:

Raspberry Pi, LCD Display, Wifi Module, Relay Temperature sensor, Humidity sensor, Gas sensor, Camera, Rectifier, Regulator, Resistors, Capacitors, Transistors, Power Supply, Cables and Connectors, Diodes, LED, Transformer/Adapter, Switch. IC, IC Sockets, Motor, Lamps. Some of Hardware descriptions are given below:

A. RASPBERRY PI:

The Raspberry Pi is an affordable, compact computer roughly the size of a credit card. It can be connected to a monitor or TV and operated using a standard

keyboard and mouse. Despite its small size, the Raspberry Pi is a powerful device designed to help users of all ages explore computing and learn programming languages such as Scratch and Python. It can perform many of the same tasks as a traditional desktop computer, including web browsing, HD video playback, document editing, spreadsheet management, and gaming. The Raspberry Pi 4, the latest model in the series, delivers significantly improved performance over its predecessors, making it suitable for more demanding applications.

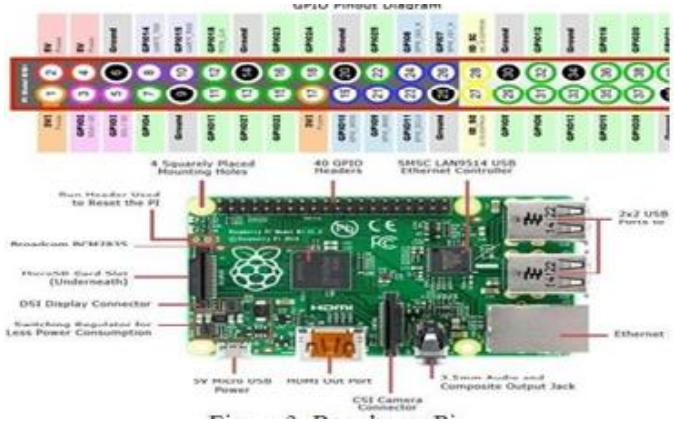


Fig – 2: Over view of Raspberry PI

B. RELAY:

A relay is an electromagnetic switch where a small control signal (usually from a microcontroller) at the input of the Relay will control a high voltage supply (usually AC mains).Since this is a Raspberry Pi based project, let us talk with respect to Raspberry Pi. The Raspberry Pi computer, although a powerful device, works on a 3.3V Logic.If you want this powerful computer to control your electrical loads, like an LED strip running along your garden or kitchen, you cannot interface them directly as the electrical loads work on AC Mains supply and the Raspberry Pi works on 3.3V DC (technically).

C. RELAY MODULE:

Even though the Relay Coil needs a small current in order to get energized, driving it directly from Raspberry Pi (for that matter, any Microcontroller like 8051 or Arduino) is not a good idea.

A simple way is to drive the Relay Coil through a Transistor. The following image shows the connections required with respect to a Relay.

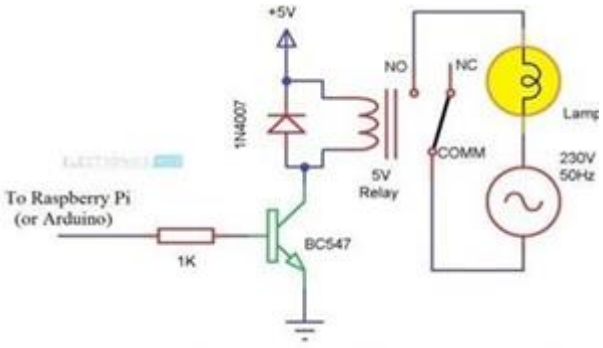


Figure - 3: Block Diagram

The circuit shown above will drive a relay with minimum number of components (a Transistor, a current limiting resistor, a Relay and a Diode).

A Relay Module is a simple circuit board that consists of the relay itself and all the necessary components that are required to drive a relay and also the required connectors to connect the load.

D. Temperature Sensor

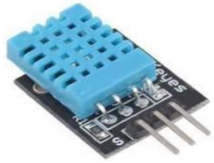
A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes.

The DS18B20 temperature sensor is perfect for projects like weather stations and automation systems. these sensors are easy to set up on the Raspberry Pi. They're the same size as a transistor and use only one wire for the data signal.

Figure -4: Temperature Sensor

E. Humidity Sensor

The DHT11 is a low-cost temperature and humidity sensor. It isn't the fastest sensor around but its cheap price makes it useful for experimenting or projects where you don't require new readings multiple times a second. The device only requires three connections



to the Pi. +3.3v, ground and one GPIO pin.

Figure 5: Humidity Sensor

F. Pi Camera Module

The Pi camera module is a portable light weight camera that supports Raspberry Pi. It communicates with Pi using the MIPI camera serial interface protocol. It is normally used in image processing, machine learning or in surveillance projects.

G. Wifi Module

The emergence of low-power, cost-effective Wi-Fi modules has significantly transformed wireless sensor networks. Modern autonomous Wi-Fi-enabled sensors can directly connect to standard, widely available wireless infrastructure. These sensors transmit data over standard TCP/IP protocols, allowing users to access real-time information from anywhere in the world using a computer or smartphone.

In the past, wireless sensor networks typically relied on proprietary protocols operating on sub-gigahertz radios. While these systems offered extended range, they were closed and often inflexible. Similarly, Zigbee-based sensor networks also operated within closed ecosystems. Both types of systems required additional gateway hardware to connect the sensor data to the internet or a local network. These gateways not only added cost but also introduced a single point of failure.

H. LCD Display:

To display sensor or device status information, a simple 16×2 LCD screen can be used. Unlike complex and expensive touchscreen displays, this basic LCD is ideal for showing short messages or key data output from the Raspberry Pi. It offers a practical and low-cost method to monitor the system locally.

3. SOFTWARE USED

i. Raspbian OS:

Raspbian is a free and open-source operating system based on Debian, specifically optimized for the Raspberry Pi platform. It includes a collection of essential software and utilities required to run and manage the Raspberry Pi effectively. Designed to deliver enhanced performance, Raspbian is particularly efficient in handling applications that involve intensive floating-point arithmetic. The advanced instruction set of the ARM11 CPU in the Raspberry Pi also contributes to overall improved execution speed across various applications.

ii. Apache HTTP Server:

The Apache HTTP Server, commonly known as Apache, is one of the most widely used and influential web server applications in the world. Originating from the NCSA HTTP server, Apache played a major role in the early expansion of the World Wide Web. It is developed and maintained by an open-source community under the Apache Software Foundation. While it is most commonly deployed on Linux systems, Apache is compatible

with a wide range of operating systems, including UNIX, FreeBSD, and Solaris.

iii. TCP/IP Protocol Suite:

The embedded web server software on the Raspberry Pi utilizes the layered architecture of the TCP/IP protocol suite. This suite enables seamless communication between computers of varying sizes and operating systems by providing a standardized set of communication protocols. The protocol stack is organized into multiple independent layers, each handling specific network functions. The Link Layer includes the network interface card (NIC) and its corresponding device driver in the operating system. For instance, an Ethernet controller driver manages the physical Ethernet interface, while the Network Layer handles addressing and routing of data across the network. This modular structure ensures reliable, scalable, and flexible communication in both local and wide area networks.

III. APPLICATION

Sensors can be used in manufacturing and the workplace. over a vast area of devices and instruments Artificial Intelligence and the Internet of Things are used to manage and track components. Hospitals and laboratories: We can position sensors on the patient's body, and the doctor can check the patient's current status on his Android phone, as well as take the required actions and decisions.

IV. FUTURE SCOPE

With reference to this system we add the various parameters and make the industry is fully automated. We use weight sensor, PH sensor, color sensor, length and domination sensor. Using this sensor to reduce the time, effort of employ and authorized person take quick decision and improve the production. The overall this thing can be done by Internet Of Thing (IOT).

V. CONCLUSION

In conclusion, the implementation of these platforms enables real-time data access and effective monitoring of devices connected to the system. This project represents a significant step forward in intelligent automation, utilizing a smartphone as the primary interface to manage and control devices in a home or workplace environment. Given the widespread use and availability of smartphones today, the need for additional dedicated hardware is significantly minimized. This not only reduces overall project costs but also enhances convenience and ease of operation.

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