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Plant Prototype Using IoT

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Abstract

Internet of Things (IOT) is propagating and blooming technology and plays an important role in Industrial Automation Systems (IAS). The evolving IoT techniques if effectively used, addresses many problems in Industrial Automation for example scalability, interoperability, Automation Domain Constraints etc. In this paper, we are presenting the plant prototype for industrial automation using IoT (IoT). The system uses Raspberry pi [1,5]microcontroller and server which is responsible for collecting data from the various industrial sensors and to send control signals to the sensors. The main feature of this system is to control and monitor the field devices, and to display the status of temperature and humidity sensed through GUI. The sensed data from field devices will be sent to the Raspberry pi server so to be accessed remotely at the end devices. End devices can also send control signals to sensors and relays through Raspberry Pi.

Keywords: *IoT, IAS, Raspberry Pi, Field Devices Industrial Automation, M2M communication*

I. INTRODUCTION

Currently, IOT has paved way for connecting huge number of devices to the Internet which provide many effective and Beneficial techniques for Automation. The Internet connectivity allows access to IIoT data and supporting applications from virtually any device, any time, from any

place in the world. The Industrial Internet of Things (IIoT) is the use of Internet of Things (IoT) in manufacturing plants which incorporates machine learning and big data technology, harnessing the sensor data, machine-to machine(M2M)communication and automation technologies that have existed in industries for years. The most conventional way to monitor and control data in industrial application is using a PLC [4], network switches, server, router and SCADA [4,5]. But installing this system architecture requires large expenditure and high maintenance. Moreover, it involves a mess network architecture which accounts to large stretch of wires around the network. Thus, the maintenance becomes difficult and costly. Aligning and synchronizing of these devices are very complicated. In this project, we are using IoT which is the trending concept for industrial automation in place of conventional method. To design this system, we are using Raspberry pi as microcontroller and the various sensors to sense the data. The real time data is captured by raspberry pi using GPIO pins. In response Raspberry Pi can either send the control signals to the sensor or upload the sensed data to the server. The advantages of the plant prototype system presented in this paper are as follows:

1) The setup and maintenance cost of the proposed system is low.

2) Aligning and synchronizing the devices is easy.

3) Remote control of devices which saves the time and effort

4) The proposed system is robust and reliable.

This paper briefs about the components used to build the plant prototype, procedure followed to develop the system and provides experimental observations and results with conclusions.

II. DESIGN AND IMPLEMENTATION

The fig 1.1 shows the plant prototype system. In this system we are using RaspberryPI ver.3, Temperature Sensor, Relays, Fan, Heating coil, PCB boards, LED’s and switches.

Working:

The Raspberry PI board is interfaced with the temperature sensor, Fan and Heater. Temperature of water is measured by using LM35 sensor. LM35 sensor senses the Temperature continuously and sends the

sensed temperature to the Raspberry PI board. The sensed temperature reading is sent to the user interface for monitoring purpose. Power plants in industry should be maintained at a particular temperature. If the sensed temperature goes below or above the set temperature range, then the heater is turned on/off respectively using relay so that the temperature is maintained within the range.

The system has 2 modes of operation: Manual mode and Automatic mode. In Manual mode the process is going to be controlled from the controls provided on the PCB board. In Automatic modethe process is going to be controlled from GUI. Raspberry Pi uses a light weighted message protocol MQTT, to send and receive the data. The data can be accessed by the applications running on end devices for monitoring and management purposes. MQTT is a binary client-server publish/subscribe messaging transport protocol, standardized by OASIS. It is built over TCP/IP protocol. The MQTT implements the brokered publish / subscribe pattern. In this pattern the clients do not know each other, but they publish message or subscribe to a particular topic, the message broker, filters all these incoming messages and distributes them to the subscribers who have subscribed to the same topic.

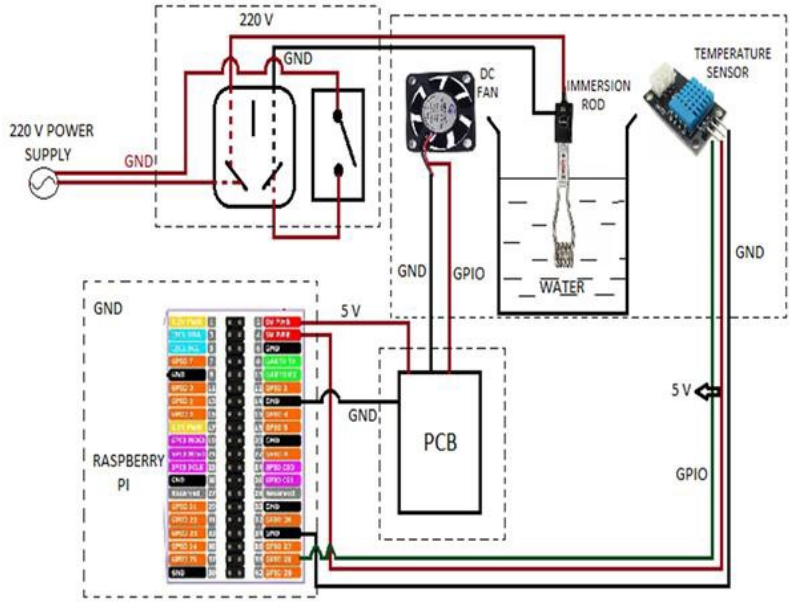

Figure 1. Proposed system setup

The system is controlled by Graphical User Interface. At first the application is connected with WiFi module's IP address and then the data are sent to the Raspberry pi through Wi-Fi module. Raspberry Pi acts as the central authority for controlling the system.

III. ALGORITHM

The algorithm used behind the proposed design is as follows:

1) The hardware setup is shown in fig1. The circuit is permanently soldered on PCB, with a power supply of 5v from the raspberry pi.

2) Raspian operating system is installed on Raspberry pi which is a Linux based OS. Python programming language is used in this system to communicate with General Purpose Input Output (GPIO) Ports.

3) One GPIO pin is connected to the temperature sensor and the other GPIO pin is connected to the fan, which are controlled through Raspberry Pi. Whereas the heater is controlled by relay.

4) Set up the MQTT server for the communication between Raspberry pi and end devices.

5) On reaching a level below the threshold temperature, heater is turned on and on reaching above the threshold temperature heater is turned off. These connections are controlled via relays.

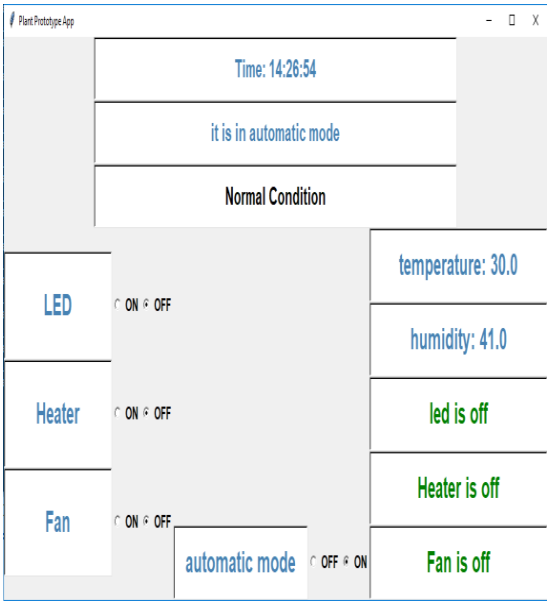

Figure 2. Graphical User Interface

IV. OBSERVATIONAND RESULTS:

The temperature sensor senses the water temperature and sends the sensed value to the Raspberry Pi, to publish the value to the GUIthrough mosquitto broker, so that the user can view the temperature. Power plants

need to be maintained at a particular threshold temperature, set by the user at the beginning phase. If the sensed temperature crosses the desired threshold value, the user is alerted to take necessary actions (to turn on/off the heater). In the system we are controlling fan, heater and lights in the industry remotely through GUI. The status of each device (whether on/off) is sent to the GUI, so that the user can know the current status. We can turn on/off the devices remotely with the help of the GUI if only it's in automatic mode. If the user is in manual mode, then he cannot operate the devices through GUI. He can only operatethem through buttons/switches.The Plant Prototype isaccurate and helpsus in taking real time actions without anydelays.Even the slightest change in the sensed temperature is reflected on to the GUI immediately. The threshold values for the temperature can be set based on the requirements of the individual plants.

VI. CONCLUSION AND SCOPE FOR FUTURE WORK

In this paper, the main focus is on developing a technology which provides a cost-effective solution to Industrial Automation. Through internet connectivity, the flexibility in controlling system can be enhanced. The specifications of this system and the ease of implementation aids large scale manufacturing and its acceptance in the industrial domain. The future scope of this project is to harness the sensed data into the database and to predict the lifetime of the devices by using big data analytics. In addition, the leakage of chemicals could be identified and necessary actions could be taken.

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