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REMOTE MONITORING FOR AUTOMATION DEVICES IN TEXTILE INDUSTRY WITH IOT AND WEB TECHNOLOGIES

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ABSTRACT

In automation, various indicator LEDs are used to continuously monitor the status of the operating devices. Not only it is difficult to follow errors in physically bigger machines visually from the panel in case of error, but it may also require more than one human operator. The above problem can be overcome by employing today's developing Web and IoT technologies. In this paper,we describe such a methodology based on the ESP8266 SoC WiFi module and the WebSocket protochol. With the ESP8266 WiFi module, which is cheap and commonly available, it is relatively easy to monitor the operating status and input / output data of industrial automation devices. Moreover, the WebSocket technology can enable one access information dynamically via a mobile device anywhere in the world. In this paper, we present how the above tools can be combined effectively to develop a software tool to monitor physically bigger machines operated by ELIAR, a leading company in the textile automation industry in Turkey. In particular, we present how the status information on the digital output module T7DO32, which is part of the remote input / output device of T7RIO produced by ELIAR, can be instantly monitored wirelessly via mobile devices including smartphones and how this technology can be extended to similar applications.

Keywords: Textile. T7DO32. T7RIO. WiFi.

1. INTRODUCTION

The LED indicators of industrial control devices are very important for operators and technicians at any moment of trouble. As an example of large machines, textile paint machines are very difficult to diagnose the problem with a single person. One person may need to stand at the beginning of the panel and the other person at the problem side of the machine. In some cases more than two people may be needed. At this point, it is possible to overcome this problem with various IoT technologies and solve other problems in general terms when overcoming this problem. Even without the LED indicators, it is possible for one person to observe the industrial device, with any intelligent device (smart phone, tablet), easily without touching the industrial control device that they want to monitor, with existing IOT technologies. Various microcontrollers, which is designed for IoT environments, have been developed to apply these technologies at the hardware layer. The chip used in this application is the popular ESP8266 named processor which has integrated TCP / IP protocol. Ajax or Websocket protocols can be implemented in the ESP8266 server to up- date data dynamically in the web environment.

The ESP8266 microcontroller integrates a Tensilica L106 32-bit RISC processor, which achieves extra-low power consumption and reaches a maximum clock speed of 160MHz. It is suitable to intagrate it to your system. Also The Real-Time Operating System (RTOS) and Wi-Fi stack allow about 80% of the processing power to be available for user application programming and development. ESP8266 is designed for industrial environments, because of its wide operating temprature range. With integrated TCP/IP stack, ESP8266 can be best choice for the industrial IoT applications [1].

To make an as asynchronous communication between web server and client, Ajax(asynchronous Javascript and XML) and Websocet is available. Ajax is used update content of the webpage when a client make an action. An Ajax request is sometimes called an XHR reques (" Xml- HttpRequest"), which is the name most browsers give the object used to send an Ajax request [2]. It is the old way for dynamic communication. Before Ajax, the web page has been largely built around the so-called request/response paradigm of HTTP. A client loads up a web page and then nothing happens until the user clicks onto the next page. Around 2005, Ajax started to make the web feel more dynamic. Still, all HTTP communication was steered by the client, which required user interaction or periodic polling to load new data from the server [3].

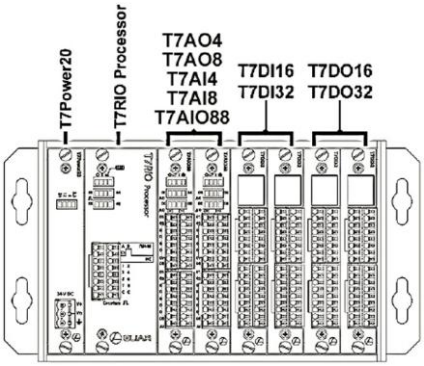

Figure 1. T7RIO remote I/O and its modules.

Websocket is a new technology that makes it possible to open an interactive communication session between client and server. With this API, you can send and get data without having to poll the server reply. Websocket is bidirectional full-duplex protocol. Data packets can be send and at the same time it can be taken [4, 5]. Result of our experiments say that Ajax is not suitable for such an application because it opens a communication and never close it, which pretends to make it as an asynchronous communication [6]. When the access point, which ESP8266 is connected, has a much traffic, at this time, if one more than clients try to connect to it, then ESP8266 is lost. Because, for one client, open connection can not be a problem if the network is well designed.

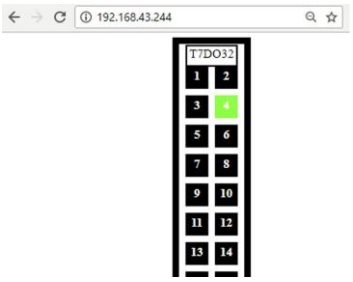

Figure 2. Example design with Javascript and CSS.

Therefore even if the network is well designed, one more client try to conect to ESP8266 server to take or observe some information of the industrial device, then the server will be lost, so you need to restart the circuit which connects to the ESP8266. Furtheremore, if such a problem occurs, operators or technicans can not understand the trouble, which can lead to other, more severe consequences. On the other hand, with websocket technology it is not worried about long polling. Much more than connect to the websocket server safely. This is because, websocket is not open connection forever. It opens then it closes. So, much more stable communication can be established with the clients, who are technicians and operators or anyone who wants to get the information about input/output situations on the industrial device, and the ESP8266 server [7].

2. APPLICATION

2.1.Interactive User Interface

With ESP8266 server and its integrated TCP/IP stack, it is possible to make an interactive user interface for clients who wants to try to get the information about the status of LEDs on the industrial device. Design can be done with css (Cascading Style Sheets). There is a point to note in this design made on the ESP8266 server. HTML design which is implemented in the ESP8266 server, can be sent to specific port number via TCP/IP. The ESP8266 sends all data packets over TCP/IP in one go, it has no feature to split into multiple parts. Therefore, if a long data packets is sent, it will not be able to perform other tasks in its vicinity due to the transmission time, then it will lost or reset. If the HTML codes are written in old way, each division will mean extra data packet to sent. To overcome this problem, implement HTML definition with JavaScript, this will make a noticeable reduction in the data packets, so the data transmission time will be reduced.

2.2. Hardware Implementation

ESP8266 is connected to the industrial control de- vice, which is for especially textile automation, name is T7RIO produced by ELIAR. T7RIO is a modular remote input/output control device. There is a CPU which controls the all modules reactions. All input/output information of the modules on the T7RIO are available in the CPU module, so the ESP8266 chip is connected to the main processor on the CPU module, then we can simply listen all input/output information with it. We observe data for only one type of module, which is T7DO32, for this exercise.

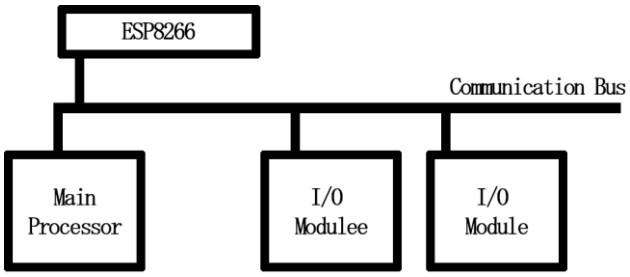

Figure 3. How ESP8266 connected to the main processor.

T7DO32 is the one of the module of the T7RIO. It has 32 digital output, so we can observe all of the digital output states with our smart devices which are connected to the ESP8266 server, dynamically. ESP8266 has limited hardware interfaces like UART, SPI. That is why, ESP8266 should only control the WiFi network and listening the main processor. If the ESP8266 is inside the housing of the PLC and the housing material of the PLC is not suitable for WiFi signals, for instance any conductive type of instrument, WiFi signal is reduced. Then there will be performance problems. To overcome the problem there will be two way. First get external antenna on the outside of the box, if the housing is not suitable for antenna, then the second solution that use access point which has strong WiFi signal. Of course for two of the suggestion, network where ESP8266 is connected, must be isolated to other networks on the worksite.

3. RESULT

With ESP8266 SoC WiFi module and websocket protocol, it is possible to observe hardware layer data dynamically from any mobile devices. Also this can be extended to other nertworks, which means the data can be seen from anywhere in the world, for much more than one client at the same time. This brings a flexibility in the automation industry for people who wants to see any status or information about the control devices.

Also, due to methodology, there will be no need LEDs on the industrial device any more. Which decreases the production time, and saves money. Furthermore, When LEDs are not used, probably, there will be extra space on the PCB for hardware designers.

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