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DESIGN AND IMPLEMETATION OF INDUSTRIAL AUTOMATION USING IOT

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ABSTARCT

Today, Automation plays an important role in human life. Industrial Automation allows us to monitor and control Industrial appliances like machines, motors, fans, lights and AC etc. It also provides security to the industries. Industrial Automation is not only meant for human efforts but also for energy efficiency and time saving. The main objective of industrial automation is to monitor and control all the industrial appliances and to alert the employees in critical situations. This paper put forwards the design of industrial Automation using Arduino mega processor with the help of Internet of Things (IOT).The industrial appliances are connected to the Arduino processor and the communication is done through internet. The status of the appliances can be viewed in a webpage. The cost of the system is very low.

Keywords — Industrial Automation; Internet of Things; Arduino.

I. Introduction

Recently, human's work and life are increasingly tight with the rapid growth in the development of communications and information technology. The society has changed human being's way of life as well as challenged the traditional residence and also living standard keeps raising up day by day that people have a higher requirement for abode functions.

Industrial automation is the use of control systems that handles different processes and machineries in an industry to replace a human efforts. The purpose of automation was to increase productivity and to reduce the cost associated with human operators. Nowadays, the focus of automation has shifted to increasing quality and flexibility in a manufacturing process. Industrial automation eliminates healthcare costs and paid leave and holidays associated with a human operator. Although it is associated with a high initial cost it saves the monthly wages of the workers which leads to substantial cost savings for the industry.

The maintenance cost associated with machinery used for industrial automation is less because it does not often fail. If it fails, only computer and maintenance engineers are required to repair it. Industrial automation fulfills the aim of the industry to run a manufacturing plant for 24 hours in a day 7 days in a week and 365 days a year. This leads to a significant improvement in the productivity of the industry. Automation alleviates the error associated with a human being. It produces better outcomes because of less errors. Industrial automation can make the production line safe for the employees by deploying robots to handle hazardous conditions.

II. Internet of Things Technology

The Internet of Things (IoT) is the network of physical objects that enables these objects to collect and exchange data through

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internet. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit; when IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, smart homes, intelligent transportation and smart cities. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure.

III. EXISTING METHODOLOGIES

Currently there are no systems at cheaper prices. Various systems are very hard to install and difficult to maintain. The various existing systems are described below have some of the demerits.

1. Java-based automation system through World Wide Web integrated into a PC-based server at home:-In this system the drawback is PC should always on & connect to the server. The implementation cost is very high.

2. Home automation system by using Bluetooth:-This system drawback is limited range and limited no of devices to be connected. The power consumption Bluetooth enabled devices was high.

3. Home automation system by using Zig bee:-This system is implemented based on Bluetooth. It overcomes some of the drawbacks of Bluetooth system but it is also lack of range.

4. Home automation system using GSM:-After rapid growth of GSM networks this system is implemented. Compared from above system this system consumes less power & standalone but the drawbacks are when GSM networks fails to deliver the commands in time major problems occurs.

Only less numbers of standards for an industrial. So we are developing the industrial automation which monitors and controls the different appliances from the remote place through the IoT.

IV. Proposed methodology

In our proposed scheme we are using Arduino as a main controller. Arduino gets the data from industrial environment and process the data to run the industrial appliances smoothly. Normally temperature in industrial environments are high when compared to normal situation because industrial machines produces more heat, which affects the machineries. Temperature sensor monitors the temperature and give the values to Arduino.

Based on the value either the fan is switched ON or OFF through relay. Further we can monitor and control the industrial appliances through internet. To send the information to internet Ethernet shield is used. To monitor and control, we are creating a web page that will display the information about an industrial situation.

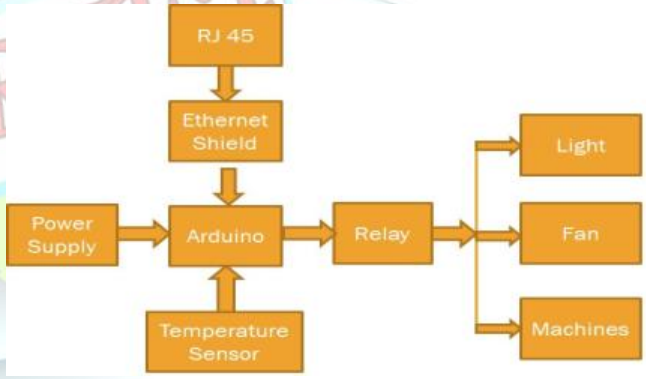

Fig1: Proposed Architecture

By implementing this we can increase the lifetime of devices and machineries are monitored and controlled remotely.

V. Research challenges

The master node has a RJ45 communication interface used for computer and Arduino Ethernet board for wireless data transfer between other nodes in the system and a microcontroller unit to manage

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all the data transfers. Also there exists a low cost microcontroller to maintain the communication between nodes. The final node in the list is the hardware connected to the actual devices to be integrated to the system. This node is also formed of an communication unit to connect to the manager node plus a component to establish communication between devices connected on the node and a microcontroller to organize the data flow to and from the master.

A. The PC Unit

The control of devices is established and their condition is monitored through the internet. As the manager unit a computer has been used. The programs that are running on the computer are listed as follows:

- Web server and Internet Web Page
- Database and its platform
- User Interface Program

Through the internet we can access an Arduino board directly. The status changes that are reflected to the database are transferred to the device through first the master and then to the slave nodes, which will be described in the next section. The connection to the web page is secured through the server certificate and the SSL algorithm. In addition a login/password based access is setup to prevent unauthorized accesses. With the internet page, authorized users can login to their home environment, monitor and change the status of the devices of their choice. Database is formed of three tables internally: Divisions of the house, devices and tables storing the status of tables Microsoft SQL Server is used for the database and DB Artisan for database management. Under a single device number there may be different states stored indicating different status of the devices at different time intervals. Thus with this system history for each device can be stored and retrieved for later processing. A user interface is built to bridge the database with the hardware attached. Along being a user interface this program with certain intervals synchronizes the status of the devices to match their status with the database value. If there is any change in status of a device in the database, this change is synchronized with the device. Similarly the statuses of the devices are updated on the database as the conditions on devices change.

B. The Nodes

The hardware part is formed of two main parts; the master node and the slave nodes. The nodes direct the devices that are attached to with the information received from the master node and inform the master with the status information of these devices.

The master node's duty is to transmit the information that is directed by the computer to the nodes and to transmit the reply back to the computer. The master node establishes the communication to the computer via the wireless link node. The communication between the master and the slave nodes is established through RF. The modulation of the RF communication is performed using an FM modulator working at 433MHz frequency and 9600Kbps speed. The RF was a low cost communication decision and the reliability has proved to be sufficient for a reliable communication. The master node is connected to the sub nodes and to the computer through a switching circuitry. The information that is sent and received is simultaneously displayed on the LED indicator in encoded form for test purpose.

The master node is designed to work as a standalone unit where the computer connectivity is not absolutely necessary to maintain the regular operation of the devices except making modifications or monitoring on them. Slave Nodes, are connected directly to the devices to be controlled. By querying the slave nodes the status of the devices can be acquired.

The initial task of the nodes is to check first if the information sent by the manager node is directed to their node ID. After this, the nodes check if the data sent belongs to one of the addresses of a device that is attached. If the device ID matches one of the devices attached then the necessary changes are performed by the node and the status of the device is updated and sent back to the manager node.

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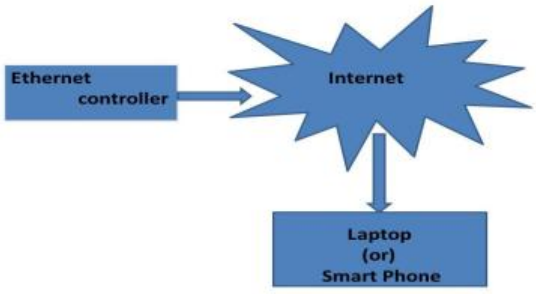

Fig2: Interface between internet and devices.

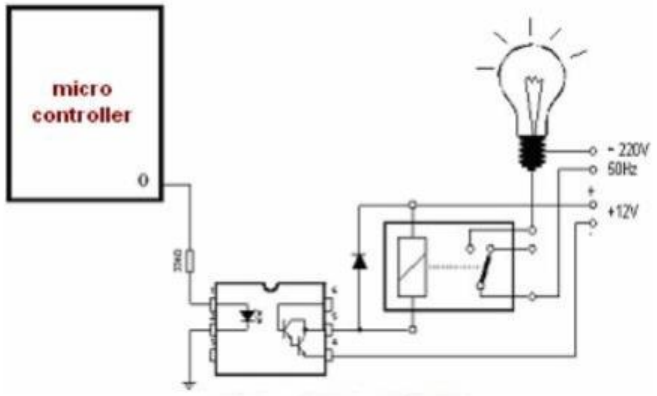

Fig3: Simple light control

The devices to be used in the automation should be grouped initially with respect to the classification of the common commands that the devices can handle. For example the events like on/off action, motion detection, fire alarm is classified into a single group since these only require a certain similar action commands to perform. A sample application for on/off operation of a device. These devices can use a similar interface circuitry if they are included in this group. For a device in this group where a limited set of instructions are adequate the instruction format. In this format, 7 out of 8 commands are currently used, which can fit in the command word using only 3 bits of the byte. These commands can be an On/Off command in the simplest sense or an alarm or some other predefined settings to a certain level of light intensity.

The other devices such as the ones that require an analog signal control can also be classified in a different group such as a Volume Switch, a Dimmer or a Heater. In this way the devices using a complicated set of instructions can also be controlled. This format is more suitable as an input to a D/A converter.

In this group of devices, it is not possible to control these devices using only 7 different instructions as in the previous simple configuration. Devices in this group need more information to define their status thus their instructions are more complicated. As the properties of these devices increase, the bit size used for an instruction is increased. These groups of devices are communicated through 9 bit instructions allowing adjustment up to 512 different settings. In addition, in this more complex format the device number is increased to 32 instead of 8 as in the previous case.

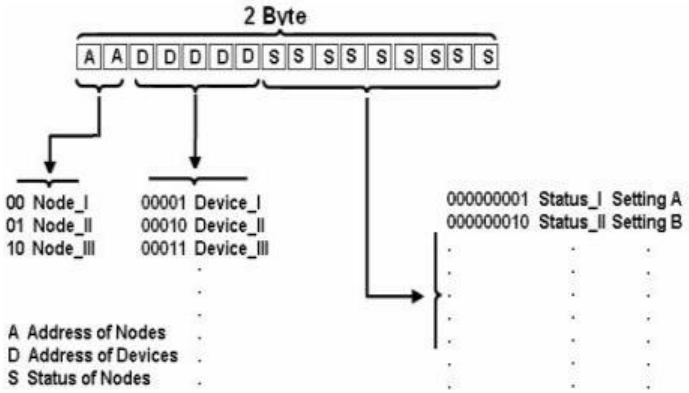

Fig4: Complicated set of functionality

During the transmission between the master node and the other nodes, CRC error checking mechanism and the Manchester coding techniques are used to ensure the integrity of the data. The nodes and the manager node use a query reply

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communication protocol. As the nodes are queried, they return their status to the manager node. In the verification of a reply being received by the slave node, the slave sends back the exact command to the device that is sending the command. For instance, if a node receives a command for a change in the status of one of its devices, it changes the status of the device first, and sends back the same command to the Master Node. Similarly when the nodes are asked about the status of its device the reply is again the command received with the status information to complete the transmission.

VI. Conclusion And Future Work

In this paper we have introduced design and implementation of a low cost, flexible and wireless solution to industrial automation. The system is secured for access from any user or intruder. This system can be used as a test bed for any industrial appliances that we can access from anywhere through internet.

The full functionality of the industrial automation system was tested and the wireless communication between an Ethernet shield and Arduino. For future work further we can try to reduce the energy consumption and implementation complexity.

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