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Research Article

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Remote Management of Smart Equipments and Services in Manufacturing Industry through IoT Applications Using Android Compatible Devices

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Abstract—

The Internet of Things (IoT) is a computing concept that describes a future where every day physical objects will be connected to the Internet and be able to identify themselves to other devices. In the future, every device is more likely to be connected to the web directly with the users expecting it to be responsive to their needs.[1] In this project, three modules are created which is used to monitor various environmental parameters and update it real time data to a server. The parameters measured include ambient temperature and humidity of the room, noise levels, the number of people entering and leaving the room and toxic gas detector. In case a flammable gas is detected, an alarm is triggered and an email is sent to the user's account. Arduino is used to integrate and program the hardware components with ESP8266 being the WiFi component which connects to the host webpage. The server side is created on an IoT platform, Ubidots.

Keywords— Internet of Things(IoT), monitoring, Arduino, ESP8266, Ubidots, wireless sensor networks

I. INTRODUCTION

Now- a- days, the industrial monitoring field requires more manual power to monitor and control the industrial parameters such as pressure, temperature, water level, etc…This is one of the most upcoming issues in the industrial sectors. If the parameters are not monitored and controlled properly, it leads to a harmful situation. Most of the industries are facing these kinds of situation because of some manual mistakes. In that kind of harmful situations, again the manual power is required to control the parameters. Sometimes, if this control process may not be handled properly, it results in an occurrence of major accidents. So, every process in the industrial sector requires more manual power which is also having issues with the unavoidable manual mistakes. With the upcoming technologies, it is very easy to overcome the greater issues in the industrial automation.

The term Internet of Things was introduced by K. Ashton in the context of supply chain management and it describes a system where the digital world is connected to the physical world forming a global network [1], [2]. A report of McKinsey Global Institute regarding the disruptive technologies defines Internet of Things as to the "use of sensors, actuators, and data communication technology built into physical objects – from roadways to pacemakers – that enable those object to be tracked, coordinated, or controlled across a data network or internet" with the goal of creating value [3]. Over the last years IoT is foreseen as the solution for the ever-increasing demand for connectivity between peoples, organizations, companies, gadgets and devices and it was born from the desire to achieve software real-time control and access to information. Based on machine-to-machine (M2M) concept, fuelled by the development of smart sensors and actuators, together with communication technologies (Wi-Fi, Bluetooth, RFID) and supported by cloud computing technologies, IoT becomes a reality and its goal is to make "things" more aware, interactive and efficient for a better and safer world. Therefore, any smart device that can be addressed by means of a communication protocol can be part of the Internet of Things. The objective of this project is to design the monitoring and control system for industrial parameters using IoT. This system mainly reduces the high manpower requirement in the industrial monitoring field by monitoring the overall industrial parameters through a single PC with the help of IoT application. This system also provides an automatic control of parameters during an emergency situation.

II. SYSTEM ANALYSIS AND REQUIREMENTS

A. Temperature & Humidity Sensor

DHT11 digital temperature and humidity sensor is a composite Sensor contains a calibrated digital signal output of the temperature and humidity. Application of a dedicated digital modules collection technology and the temperature and humidity sensing technology, to ensure that the product has high reliability and excellent long-term stability. The sensor includes a resistive sense of wet components and NTC temperature measurement devices, and connected with a high-performance 8-bit microcontroller.

DHT11 uses a simplified single-bus communication. Single bus that only one data line, the system of data exchange, control by a single bus to complete. Device (master or slave) through an open-drain or tri-state port connected to the data line to allow the device does not send data to release the bus, while other devices use the bus; single bus usually require an external one about 5.1kΩ pull-up resistor, so that when the bus is idle, its status is high. Because they are the master-slave structure, and only when the host calls the slave, the slave can answer, the host access devices must strictly follow the single-bus sequence, if the chaotic sequence, the device will not respond to the host.

B. MQ-2 GAS SENSOR

Resistance value of MQ-2 is difference to various kinds and various concentration gases. So, when using this component, sensitivity adjustment is very necessary. we recommend that you calibrate the detector for 1000ppm liquefied petroleum gas<LPG>,or 1000ppm iso-butane <I C4H10>concentration in air and use value of Load resistance that(RL) about 20 KΩ(5KΩ to 47 KΩ). When accurately measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence.

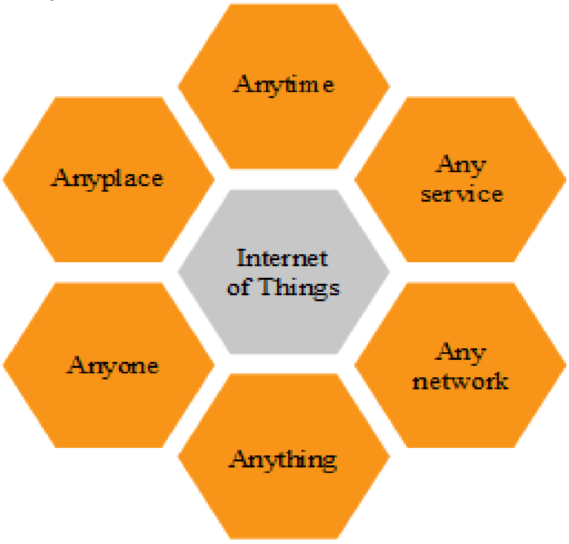

Fig1.IOT

III. INTERNET OF THINGS

Over the last years IoT is foreseen as the solution for the ever increasing demand for connectivity between peoples, organizations, companies, gadgets and devices and it was born from the desire to achieve software real-time control and access to information. Based on machine-to-machine (M2M) concept, fuelled by the development of smart sensors and actuators, together with communication technologies (Wi-Fi, Bluetooth, RFID) and supported by cloud computing technologies, IoT becomes a reality and its goal is to make “things” more aware, interactive and efficient for a better and safer world. Therefore, any smart Extensive research and great amount of time and financial resources have been invested by corporations and governments into this concept, which is also refereed as the next technological revolution [4].

A device that can be addressed by means of a communication protocol can be part of the Internet of Things. European Union research cluster on Internet of Things, defines ‘Things’ as active participants in any kind of “business, information and social processes where they are enabled to interact and communicate among themselves and with the environment, by exchanging data and information ‘sensed’ about the environment, while reacting autonomously to the ‘real/physical world’ events and influencing it by running processes that trigger actions and create services with or without direct human intervention” [3]. Therefore, the Internet of Things is both a reactive (react to changes) and proactive (initiate changes) layer of digital information, covering the real world and connecting to it. Fig. 1. Internet of Things (4)

IV. PROPOSED ARCHITECTURE TOWARDS IOT

Several architectures of how the implementation of IoT should be done are proposed in [13], [14], [15] and [16]. Nevertheless, most of them can be summarized by a simplistic view as presented in figure 2 .

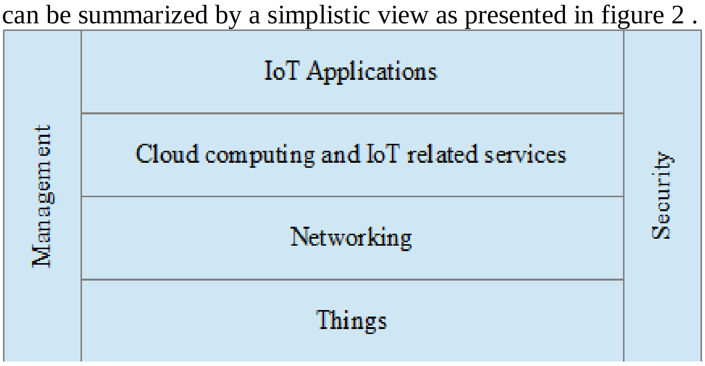

Fig. 2. Simplified generic IoT Architecture

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The goal of the research project introduced in this paper is to deliver connectivity to smart manufacturing equipment in order to allow them to be controlled and monitored by software applications running on Android compatible devices. Therefore, among the identified enablers and issues that need to be addressed, the ones of interest for this project are listed below:

- Networks of smart equipment enhanced with embedded distributed intelligence to deal with scalability challenges [3],
- Micro-electromechanical systems and sensors for augmented applications [17] or foreknowledge and awareness of things to come [3],
- Plug – and – produce and interoperable thins for efficient things communication [3],
- Extended communication capabilities for intermittent network connectivity and unique identification [3]. Energy efficient and reconfigurable things [3],
- Remote human machine interaction and interfaces; maintenance service and support [3],
- High computational power and information processing, data storage and data availability [3], [17],

Authors' vision and proposed architecture concept for deploying IoT into the manufacturing field are presented in figure 3, based on several connected research topics in the area of the above mentioned IoT enablers and challenges [17], [18] and [19]. For a better clarity, some layers of the proposed architecture are not presented, among them being: security, middleware and overall information management

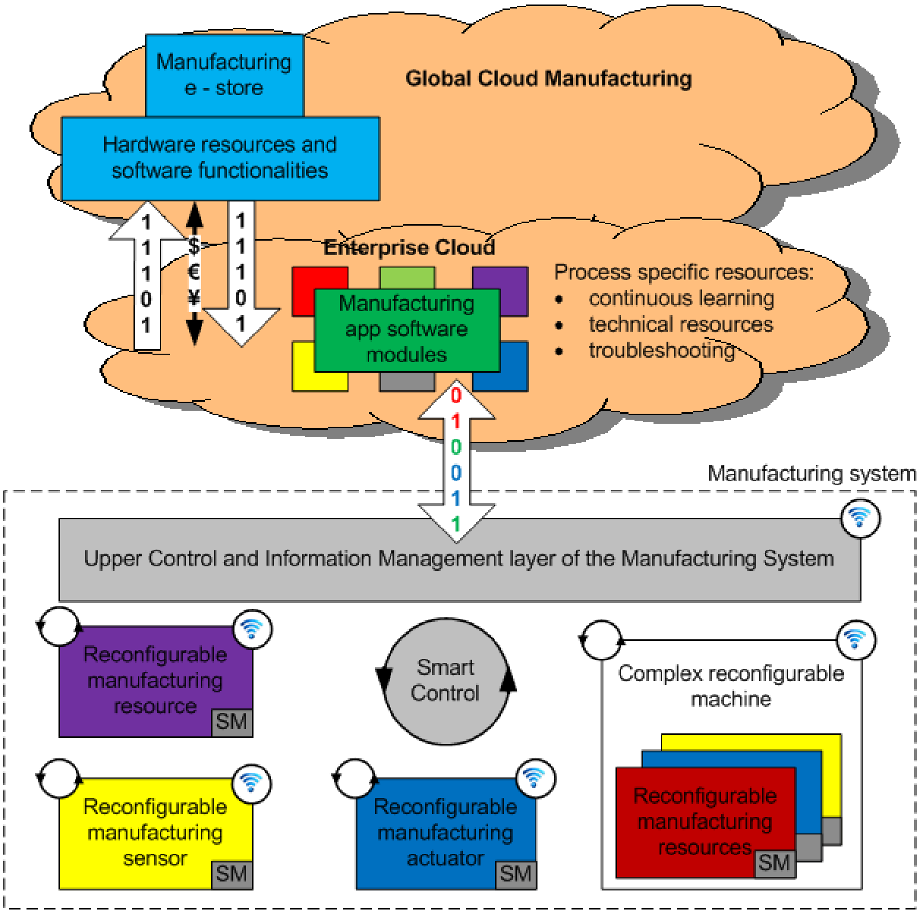

Fig. 3. Simplified view of the proposed IoT architecture for Manufacturing

A. Brief description of the proposed architecture expected outputs

As depicted from figure 3, a manufacturing system is built out of smart reconfigurable manufacturing resources that are linked by means of wired or wireless communication between them and to the manufacturing system control and information management layer. Sensors and actuators are part of reconfigurable manufacturing resources, which, if joined together, can create more complex resources obtaining extended functionalities. Smart reconfigurable resources can be considered things because they are addressable by using a communication network (wired or not) and they have the ability to process, store, send and receive data and monitor or control devices (sensors, actuators, etc.). Even more, they have the ability to communicate with other reconfigurable manufacturing resources and react to changes in order to maintain a specified process parameter set-point by different means. A smart reconfigurable manufacturing resource is enhanced with distributed intelligence, providing local control for the physical manufacturing resource, plug – and – play capability and high computational power. Even more, the hardware and software building blocks of a reconfigurable manufacturing resource can be rearranged in order to obtain a different then before functionality with a minimum effort and delay. Figure 4 presents an overview of a conceptual architecture for smart manufacturing resources

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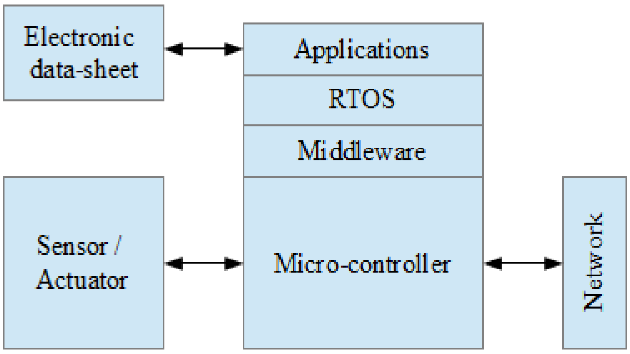

Fig. 4. Smart manufacturing resource architecture for IoT

Several experimental developments for deploying smart reconfigurable manufacturing equipment and control architectures were done by the authors in [17], [18] and [19].

The enterprise cloud is designed to be a service that will connect the manufacturing system or a manufacturing resource to a plant. It is envisaged to provide access to computing services, manufacturing information, manufacturing software applications and to support data sharing with the served process, but, not restricted to this. Enterprise cloud will allow one to remotely connect to a specific manufacturing resource,

monitor its status, enhance software algorithms or download new ones. Global manufacturing cloud represents the global network of manufacturing, whereas an enterprise could sell or buy products, raw materials software and hardware manufacturing resources, technical support and data.

There are three major expected outputs from the proposed architecture at the end of the project. First, the development of smart reconfigurable resources, allowing to rearrange their building blocks in order to fit process needs by selecting the right software applications from the enterprise or manufacturing cloud within the constraints of the available hardware modules. Out of these resources, more complex reconfigurable manufacturing resources can be achieved, leading also to reconfigurable manufacturing systems. Their development will be supported by highly interoperable modular hardware and software blocks, generic embedded systems, real time embedded operating system, intelligent information management algorithms and informational electrical- mechanical interfaces.

The second output: the graphical human-process interface will provide a more enjoyable user experience to the manufacturing processes by means of PCs, smart phones and

tablets. The interface will be used to design control algorithms for reconfigurable resources or to its modules, by using the software functionalities and technical resources available in the enterprise cloud or manufacturing e-store. The control algorithm will be transferred to the resource for which it was designed throughout the computational resource of the upper control and information management layer of the manufacturing system. This layer will be responsible for several activities: to auto-integrate the newly connected reconfigurable manufacturing resources, to support the operator in the configuration process of the newly connected resource, to provide the framework for designing control algorithms, to transfer control algorithms to the manufacturing

resource, to monitor the data received from the manufacturing resources and to take over the control of manufacturing resources if needed.

Third, the manufacturing cloud will be the virtual space of the manufacturing industry. It will provide an enterprise with access to a manufacturing e-store, allowing it to acquire, sell, test and develop manufacturing technical, hardware or software resources and know-how. The enterprise cloud will be the virtual model of a specific enterprise that will link the manufacturing cloud with the enterprise facilities. It will host information related to the enterprise and its manufacturing processes, a database with available software functionalities that can be downloaded into hardware resources and a knowledge base with technical resources and troubleshooting actions.

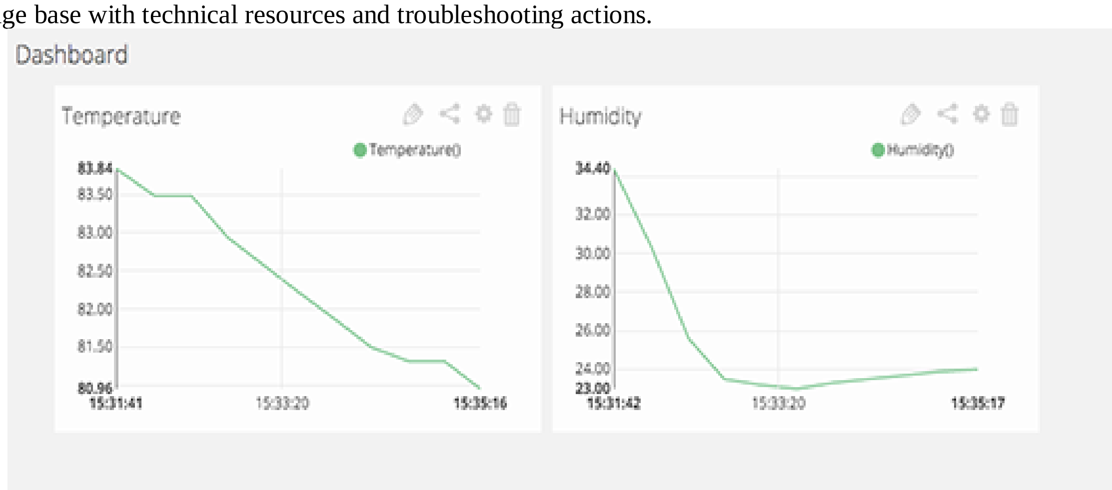

Fig 5.Variations of Temperature and Humidity Plot in IOT Platform

V. CONCLUSION AND FUTURE SCOPE

The application of the project is numerous and can be further developed to integrate more sensors which are applicable to its use in environment monitoring. It can also be used to trigger an external event or control a remote device which can be even used to mitigate critical situations. Such an external event can be such as turning the sprinkler on when there is fire or smoke detected, turning a fan on in a room when it gets too hot etc. The project can further be reduced to much smaller sizes and integrated in just a single chip which can be in the form of miniature tags.

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