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IoT Based Smart Gears System for Workers in Factories

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Abstract: Accidents in the workplace are a major problem, with potentially devastating consequences for workers and employers alike. Despite of clear safety regulations and procedures enforced by the authorities, risk management remains a huge challenge for employers in many industries. The proposed embedded system is expected to potentially reduce the chances of accidents happening in factories. The system consists of three modules: Worker module, Power tool module and Server module. The Worker module restricts access to dangerous power tools for workers without wearing proper gears. The glove with the worker unit will act as a security measure in such a way that each tool will have restricted access, according to the level of expertise of the worker. All of which is controlled by a Web Server unit which gives command to the Power tool unit.

Keywords: IoT, Raspberry PI, NodeMcu, RFID, Power Tools, Client-Server.

I. INTRODUCTION

The Industrial Internet of Things (IIoT) based system provides safety to professionals with real-time understanding of worker behaviours, machinery compliance, causes of safety shutdowns or stoppages and safety anomalies and trends. The number of serious deaths happening in the workplaces is soaring up every year. The safety and health of people is not ensured in workplaces. The workers face a lot of struggles and difficulties in the workplace due to the improper balance between work and their safety. Besides affecting them physically, they are affected mentally as well. Among all the other industries the factories stands as the leading contributor of fatalities. According to the recent report from the Bureau of Labour Statistics (BLS), there happen around 150000 workplace injuries every year.

Even with the tremendous development in technology there are very less devices/systems developed for the safety of workers. Hence, this paper works to build a safety gear for ensuring the safety of workers. Workplace safety is vital to protecting workers, avoiding production interruptions and achieving operational excellence. Multiple hardware solutions exist to protect and increase the level of safety in any power tool or machinery. A set of safety and hazard rules are placed in workspace to limit such issues. But the current technology only aims at securing the machines and devices, but does not factor-in on human errors which is one of the major issues in this case. The tools are not access-locked and any user, irrespective of skill set, can use them. If proper protective measures are not taken seriously, they can lead to serious injuries.

The remainder of this paper is organized as follows; System design is introduced in section II, Design and implementation is introduced in section III, Results and Conclusion are provided in section IV and V respectively.

II.SYSTEM DESIGN

Conceptual block diagram of the Smart Gears System is shown in Fig.1. It is an IoT based system that provides tool specific access to workers based on whether proper safety equipment has been worn or not.

The system uses sensors present on these safety gears (helmet, gloves and shoes) which collects the relevant data and send to the server (running on Raspberry Pi) through Wifi connectivity with NodeMcu. The server will check for two conditions. First it checks whether proper gear is being used by the person requesting access and then it checks whether the person requesting for the tool have the required expertise to operate that tool. Based on this information, the server controls the access to the machine through power control section of Power tool module.

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Fig. 1. Conceptual block diagram of the proposed system

II. DESIGN AND IMPLEMENTATION

The Smart Gears System consists of three modules: Worker module, Power tool module and a Server module. The Worker module consists of safety gears (helmet, gloves and shoes) which are shown in the Fig. 2 which is supposed to be worn by the worker during the operation of power tool.

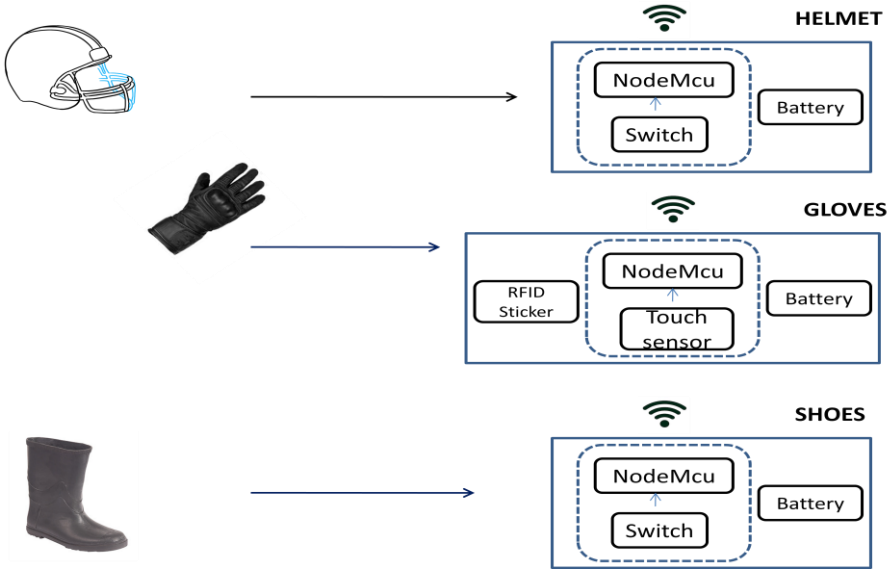

Fig. 2. Conceptual block diagram of the Worker module

The Worker module includes a wifi enabled Microcontroller (Nodemcu), capacitive touch sensor, switches and a RFID Sticker (Only in gloves). The worker in the factory who needs to operate a particular machine has to first scan his/her RFID worker card on the machine. Accordingly the Server module will check in the database whether the worker is authorized to operate the machine. If authorized, then he/she has to wear all the required Worker module safety gears (helmet, gloves and shoes). Accordingly the Worker module sends capacitive sensor readings to the Server module. The Server module analyses all the safety gear sensor readings, and if all sensor values are active then the server sends appropriate command to the Power Tool module to unlock the power tools as shown in Fig.3.

Power Tool module implemented with NodeMcu , Buzzer and RFID reader. The Server keeps on tracking all the gear status and whenever any gear is inactive the machine will be turned off by the Power Tool module as per the command from the Server. The database in the Server can be updated by the system administrator at anytime by adding/deleting the workers and their permissions to operate the power tools.

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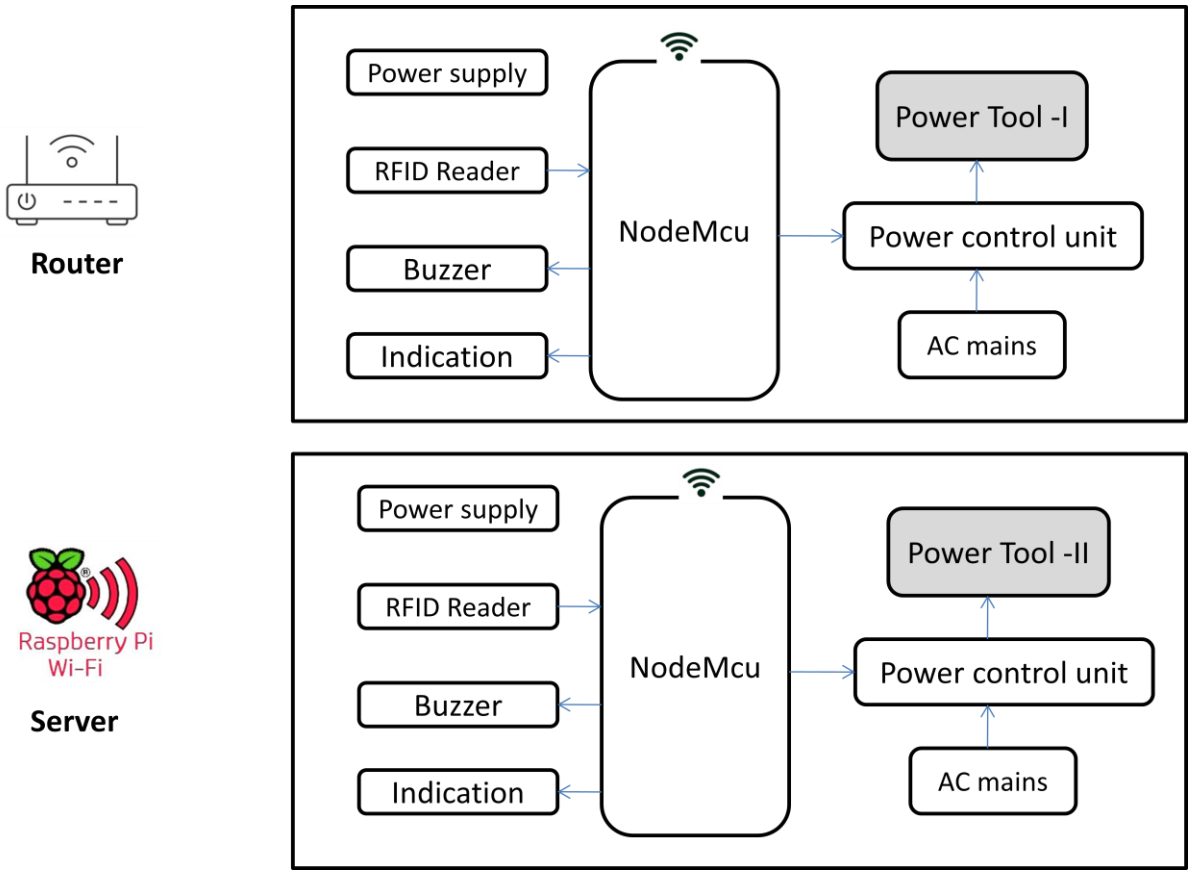

Fig. 3. Block diagram of Power tool module with Server and Router

The client-server communication in the Smart Gears System is implemented with HTTP as shown in Fig.4. HTTP works as a request-response protocol between a client and server. HTTPGET method is used to request data from a specified resource**.** POST is used to send data to a server to create/update a resource. The data sent to the server with POST is stored in the request body of the HTTP request.

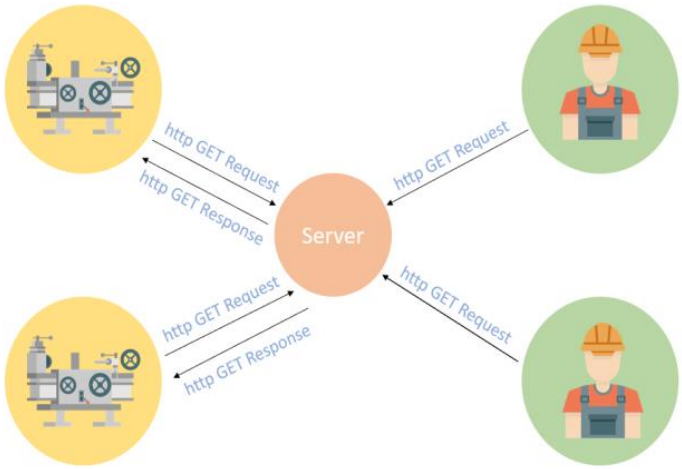

Fig. 4. Block diagram of HTTP GET request communication

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III. RESULTS

We have designed and implemented the prototype of Smart Gears System with four nodes shown in Fig.5. Two nodes among them will acts as Worker module and other two will acts as a Tool module. Each Worker module is equipped with three sensors which periodically senses the condition and informs the Server module. Based on the information received the Server module issues command to control the Power tool.

Fig. 5. Prototype of the Smart Gears System

In case there is a mismatch, server module issues the command to turn ON the warning Alarm. This process of scanning the ID is repeated in a continuous loop and hence in case the worker removes any of the safety gears at any time, warning alarm will be indicated immediately.

IV. CONCLUSION

IoT based Smart Gears System Prototype is implemented using Nodemcu, Raspberry pi and capacitive sensors to improve the safety of the workers in the factories. By using this system, constant checking of the capacitive sensor values and controlling the Power tool is done by using IoT. This system is cost-effective and efficient. The system performance can be enhanced by including additional features.

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