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Customized Smart Andon System to Improve the Efficiency of Industrial Departments

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A customized industrial system to realize the supporting requests in manufacturing lines with detailed statistical information is presented. Also called customized smart Andon system. The system is based on a software and hardware design customized for particular industry needs according to the internal organizational structure. The results of the projection are that Andon system permits an important reduction of the time required for attending and finishing whatever problem in the manufacturing line.

Keywords: Manufacturing line, Efficiency, Statistical analysis, Monitoring.

Introduction

Nowadays, the industry sector need to increase competitiveness in order to maintain their products and service in the world market. Thus, the innovation regarding the products and processes inside the company are required to minimize resources and increase the earnings[1, 2]. As a useful tool, Andon systems permit visualize the status of different processes based on selected alarm related to a particular color and, in some way, create awareness based on visual information to enhance industry efficiency. Although different classical and smart Andon systems are available, each company has its own internal requirements, which can mean a lot of time and money investment to adequate the commercial Andon to internal processes[3,4]. In addition, the visual status information has to monitor using lighting and multimedia instruments. However, sometimes the correspondent personal is not located near the visual alarms, so the Andon system turn of inefficient and the competitiveness is not increased [3, 4]. In particular, ZigBee technology has been used for Andon systems, but this proposal does not permit easy customization in order to support any change of the rules or production line modifications[5]. In addition, the Andon systems have been used for computer-supported cooperative work, which is a fundamental issue in the manufacturing sector[6]. Thus, the Andon systems also permit the analytical model of production lines in order to increase the throughput of quality products and services[7]. In this paper, we present a customized smart Andon system that permits send a request for particular problems to a particular person or department, which is not a common action of the conventional Andon systems. Also, the Andon system connected to a database permits storing all the data related to the calling or request to making smart decision to improve the downtime manufacturing line, save cost and time, traceability of status and problematic locations, among other advantages.

Materials and methods

Figure 1 shows the hypothetical complete scenario for testing the customized smart Andon system proposal. Firstly, the location of the manufacturing processes is defined according to all the production lines and manufacturing cells. In our case, two different processes were testing using the Andon system. Each process has a Humane-Machine-Interface (HMI) based on a touch screen and a single-board computer (Raspberry Pi 3 Model B) with different options for connectivity. Next, when a relevant event (e.g. support, different technical and material request, among others) occurs in the manufacturing line, the alert is activated manually by a worker using the HMI. These alert generations require particular information in order to optimize the attending for the alerts. For example, the particular support department, kind of alerts, among others. It is important to clarify that, this information is not used

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by the conventional Andon systems and also, our proposal permits the complete reconfiguration of all parameters. Next, all the calls are sending to an internal database for security reason. Thus, individual alerts are sending by electronic mail (using an E-mail server) to the corresponding support staff with information respect the alerts. In the same time, the information alerts are sending to a web server in order to display the alerts in an internal monitor. In particular, the information details respect particular call is the consecutive identification number (id), the department required (Depart), kind of call (K.C.) (Assistance and Stop), the date and time of the calling (Date-Start and Time-Start, respectively), the date and time of attending (Attending Date and Attending Time, respectively), the date and time of finish (Date-Finish and Time-Finish, respectively), the total attention time and the total required time.

Results and Discussion

Table 1 shows some initial testing results of the customized smart Andon system. For security reason, specific information regarding the date and time of the events are not related to the real manufacturing process. However, the table permits an overview of the information that the system can provide. Next, a projection was performed based on real industrial data. Thus, the data projection related to the calls (≈300) to five different departments was recorded. In this scenario, the department #1 presents a median time of ≈18.9 minutes to attending and finishing general calls. Also, ≈23 minutes and ≈15 minutes are the maximum and minimum time required for attending and finishing the request, respectively. In particular, department #5 presents the maximum values time required for attending calls. For example, the median time is 24.9 minutes, maximum value time is 27.9 minutes and minimum value time is 21.7 minutes. Thus, the same analysis can be performed for each department.Now, considering the variables that affect the delay of attending and finishing the calls in a particular industry scenario, a projection of the results is calculated using the customized smart Andon system proposed. Thus, Figure 3 shows the performance of the projection results when the customized smart Andon system is used. Making the same comparisons considered in Figure 2, department #1 presents an important reduction of the time required for attending and finishing calls. Principally, the median time was reduced from ≈18.9 minutes to ≈10.4 minutes, the maximum and the minimum time required for attending and finishing the request are also decreased, from ≈23 minutes to ≈12.5 minutes and from ≈15 minutes to ≈8 minutes, respectively.

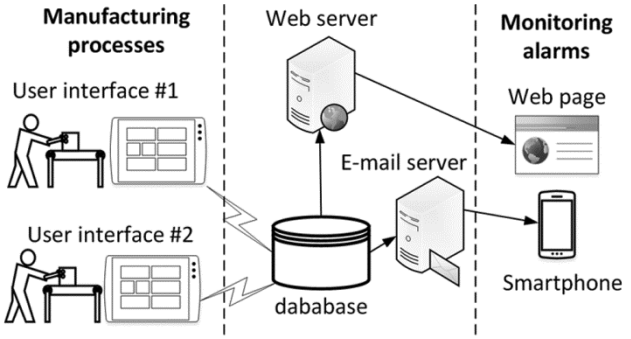

Fig. 1 — Complete diagram of the customized smart Andon system

Table 1 — Initial testing results

Id	*Depart.*	*K.C.*	*Date-Start*	*Time-Start*	*Attending Date*	*Attending Time*	*Date-Finish*	*Time-Finish*	*Attention Time*	*Required Time*
36	5	S	3/26/2019	11:40:13	3/26/2019	11:42:07	3/26/2019	11:45:02	0:01:54	0:04:49
39	5	A	3/26/2019	12:17:35	3/26/2019	12:19:04	3/26/2019	12:23:22	0:01:29	0:05:47
40	4	A	3/26/2019	12:29:14	3/26/2019	12:30:48	3/26/2019	12:32:16	0:01:34	0:03:02
41	5	A	3/26/2019	12:42:08	3/26/2019	12:44:23	3/26/2019	12:45:57	0:02:15	0:03:49
42	4	S	3/26/2019	12:55:51	3/26/2019	12:57:14	3/26/2019	12:58:36	0:01:23	0:02:45
43	2	S	3/26/2019	13:08:19	3/26/2019	13:09:57	3/26/2019	13:10:41	0:01:38	0:02:22
44	4	S	3/26/2019	13:20:04	3/26/2019	13:22:38	3/26/2019	13:23:57	0:02:34	0:03:53
45	4	A	3/26/2019	13:33:27	3/26/2019	13:34:08	3/26/2019	13:36:19	0:00:41	0:02:52
46	2	S	3/26/2019	13:46:31	3/26/2019	13:47:09	3/26/2019	13:48:36	0:00:38	0:02:05
47	3	S	3/26/2019	13:58:53	3/26/2019	14:00:15	3/26/2019	14:01:55	0:01:22	0:03:02
48	5	A	3/26/2019	14:11:02	3/26/2019	14:12:08	3/26/2019	14:13:35	0:01:06	0:02:33
49	2	A	3/26/2019	14:23:17	3/26/2019	14:24:29	3/26/2019	14:25:42	0:01:12	0:02:25
50	4	S	3/26/2019	14:35:54	3/26/2019	14:37:41	3/26/2019	14:40:13	0:01:47	0:04:19
51	1	A	3/26/2019	14:50:03	3/26/2019	14:52:22	3/26/2019	14:53:18	0:02:19	0:03:15
53	3	S	3/26/2019	15:15:33	3/26/2019	15:16:59	3/26/2019	15:18:34	0:01:26	0:03:01
55	4	S	3/26/2019	15:39:27	3/26/2019	15:41:02	3/26/2019	15:42:46	0:01:35	0:03:19

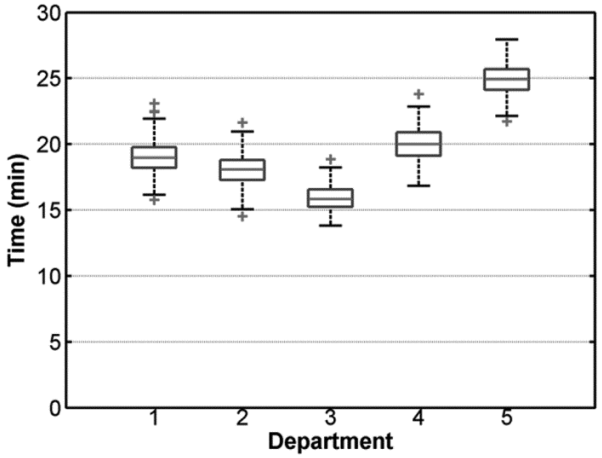

Fig. 2 — Statistical information of the required time to attending calls of 5 departments considering the requests in a one month

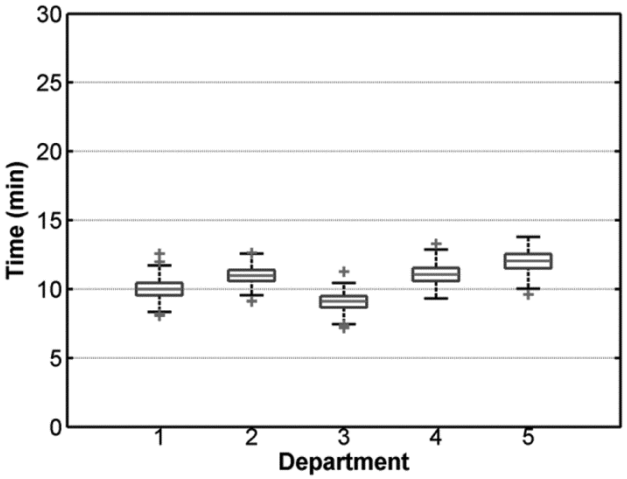

Fig. 3 — Statistical information of the required time to attending calls of 5 departments considering the requests in a one month using the customized smart Andon system

Conclusion

In this paper, an Andon system with several options to being configured and available options for statistical analysis is presented. The options to being configured means that the system can be customized based on the particular manufacturing lines requirements, which is highlighted with respect to the conventional systems. In addition, the detailed statistical analysis is an important improvement that permits enhance the quality of the products and efficiency in order to increase industry competitiveness[8]. In addition, this technical proposal can support lean manufacturing culture activities in whatever company because the proposal is suitable industrial tool or instrumentation. Finally, the system proposed can work together with other technological platforms as part of the Industry 4.0 concept.

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