Application of Industry 4.0 for Automation of Industrial Processes

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Abstract -.Internet of Things (IoT) is rapidly increasing technology. In this paper, the main target is on developing the system which can automatically monitor the economic applications and generate Alerts/Alarms or take intelligent decisions using concept of IoT. IoT has given us a promising thanks to build powerful industrial systems and applications by using wireless devices, Android, and sensors. A main contribution of this research paper is that it summarizes uses of IoT in industries with Automation to watch and control the Industry. In any large Industries, the energy devices within the Plants and laboratories are operated by hand and remain ON throughout the day. These rooms have predefined schedule and when the venues are sparingly used tons of energy is wasted if the energy devices remain ON throughout the day. A study on the estimates of energy consumption during a laboratory using the prevailing system was administered. The proposed approach exhibited significant reduction within the energy consumption by automatically switching the energy devices ON and OFF of every venue supported the schedule. Such optimization of load scheduling with the timetable of the venue intends to conserve the energy consumption. Moreover, the status of the energy devices might be transmitted over the web using IoT and remotely controlled by developing an App which given a mechanism for smart monitoring of energy devices. Furthermore, this technique are often used for smart estimation of power consumption

Key Words: Energy Consumption, Energy Management Systems, Energy Monitoring, IoT

1.INTRODUCTION

Demand for electric energy has been rising exponentially due to rapid growth in economic and Population. Considering the importance given to energy conservation in the plans and the strategies of any country, there is a need to conserve energy at different stages. Energy conservation can be at Production, distribution and consumption. To meet the national power requirements, strategic shifts from fossil fuel generation to increasing percentage of power generation from renewal sources are becoming significantly visible. This also benefits in reducing carbon footprint. Similarly numerous approaches to improve the efficiency in distribution and reduce losses are also gaining popularity. Also there are numerous approaches of improving efficiency at consumption by insulating buildings, plugging leakages in bad heating or cooling systems and efficient lighting. A significant amount of energy can also be saved at the consumer by optimizing the utilization of appliances. The proposed approach is founded on such method of conserving energy by analyzing the working schedule of large Industrial organization and using technological advancement in IoT to monitor and control appliances and optimize power consumption.

2. LITERATURE REVIEW

Research supported the cloud platform, industrial IoT and mobile services, a customization-oriented of intelligent manufacturing System is initially achieved during this paper. This technique can manage personalized customer order information science also as unmanned workshop and intelligent production. [1] This paper introduces the web of Things (IoT) and cyber- physical system (CPS) concepts in automation is undergoing an incredible change. This is often made possible partially by recent advances in technology that allow interconnection on a wider and more fine-grained scale. the aim of this text is to review technological trends and therefore the impact. In [3] computer game in context of Industry 4.0 proposed this paper. It deals with computer game in context of Industry 4.0 projects. Thanks to sufficient computing power, computer game allows visualization of virtual objects in both professional and public spheres.[4] Proposed that on IIoT architecture and information-based interaction for the economic environments in Industry 4.0. Especially, they analyzed a software-defined IoT architecture to work out network resource allocation and accelerate information exchange mechanisms through an easily customizable networking protocol. They also discussed the excising problems and possible solutions for software defined IoT.[5]. Li studies high energy consumption in large public build- ings largely affecting economy development with urbanization and hampering the socio-economic development and developed a real-time monitoring system to live energy consumption of an outsized public building that gives the idea data and relevant reference for building energy analysis and building energy saving [6]. Kamal studies the various factors which influence the energy consumption by assessing the regulation, environmental concern, social aspiration, comfort, education, activities, social marketing, per- sonality, conscientiousness, and emotional to develop strategy for energy management and sustainable campus of upper education institutions [7]. Jankovic analyses the high energy consumption publicly buildings thanks to low energy efficiency, bad heating plant , poor operation and management. Pro- poses an approach to market energy efficiency strategy and realization of sustainable development by dividing building in categories and extra measures in existing public buildings [8]. Yongshunstudies the energy utilization efficiency of building air-conditioning systems for a hotel. Analyzing the energy consumption data and energy efficiency ratio of the system by collecting the air-

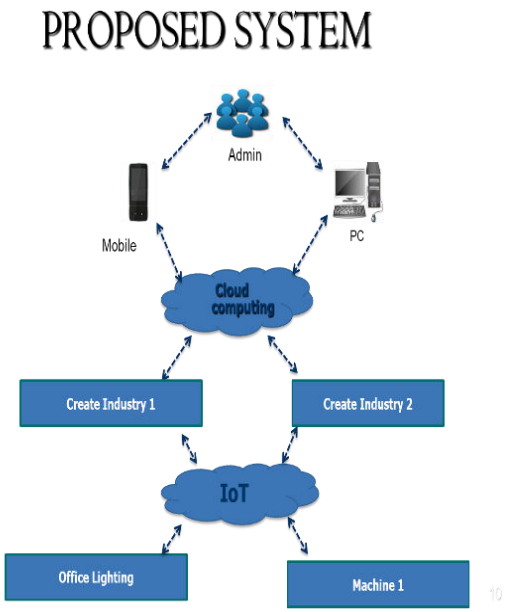
conditioning system operating efficiency index, system data and proposes targeted energy- saving recommendation of the building[9].AboZahhad analyses the transmission power to realize energy-efficient communications over AWGN channel by developing an energy model for the evaluation of communication protocols considering the physical layer and MAC layer parameters by determining the energy consumed per payload bit transferred to minimize energy consumption [10]. Wang analyses the energy consumption monitoring network in Industrial transmission lines and load branches to reducerepeatedmonitoringthatleadtowasteofresourcesandmaki ngthewhole network observed using the binary quantum particleswarm optimization (BQPSO) method. Reducing the amount of energy monitoring points to scale back cost of monitoring and effectiveness [11]. Alvaro studies the economics of a shared photovoltaic installation during a multi residential building with single consumption and therefore the impact of remuneration scheme for the excess energy with self-generated energy policy. The paper infers better optimization of economies for the sharing energy then traditional self-consumption policy and therefore the remuneration scheme [12].Bandarra analyses the choice and installation of equip- ment for energy management systems to get energy char- acterization and rationalization, visualization of kit consumption estimates, to optimize the energy consumption and analyze the info for preventive or corrective measures [13]. Apostolou discusses The GreenSoul project to realize higher energy efficiency publicly buildings by collaboration of individuals , devices and buildings with range of technology and embedding intelligencein energy consuming devices to make a decision operation mode and consumption [14]. Casado develop a framework of device layer of sensors, a choice network layer supported behavioural model and interface layer to notify occupants and adapt to scale back energy waste. Thereby, to supply an eco-system to reinforce efficiency in office buildings [15].

Summary:

Industry 4.0 is defined IoT architecture to determine network resource allocation and accelerate information exchange mechanisms through an easily customizable networking protocolIndustrial automation 4.0 in Load control and scheduling is load optimization and control is need of current industries

3. DESIGN OF PROPOSEDAPPROACH

The proposed approach focus is to automate switching energy appliances supported the predefined schedule of the premises to scale back energy utilization in Industrial organizations. Supported a study of load estimates of a industry, and an IoT based system to watch and control energy appliances to conserve energy



The diagram of the system is illustrated in Fig.1. The server contains the timetable generated for Plants and Plant of the organization and can be centrally accessed from the cloud. The timetables for each venue can be obtained from server in XML format that contains information of the room id, start time, and end time. It also contains the information for time synchronization with server. The IoT are programmed to receive and process the information from the XML file to determine A study of the energy consumption if the room id, start time and end time is for the corresponding venue and takes appropriate actions to switch the devices ON or OFF by activating relay modules. The Real Time Clock (RTC) provides the IoT with the current time. The current sensor senses the current through theappliances and provides input to the IoT, which computes andreturns the energy consumption status to the server for datalogging and monitoring the venue. To avoid inappropriateswitching or allow unscheduled utilization of venue, theautomated system control can be overruled by a manualswitching. Also the mobile app is developed to access theserver, monitor and control

A. Sample study on estimates of energy consumption

System of the electrical appliances during a sample venue aindustry was conducted. Under normal working conditions the devices remain ON for duration of 14 hours daily. Energy consumption estimates during normal working hours..Energy consumption estimates during normal working hours is summarized in Table no 1

Table1.Summary of estimate and saving

Consumption estimates under normal condition	17737.72 kW/year
Consumption estimates with proposed approach	10642.632 kW/year
Percentage saving	(17737.72−10642.632) /17737.72 = 40%

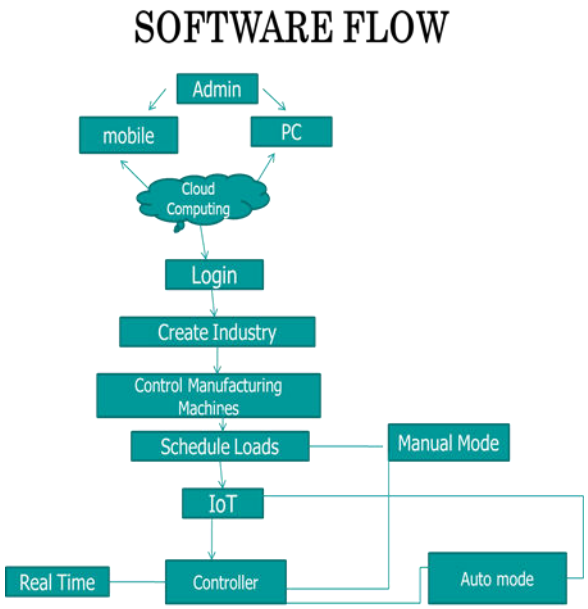


Fig.1 software flow

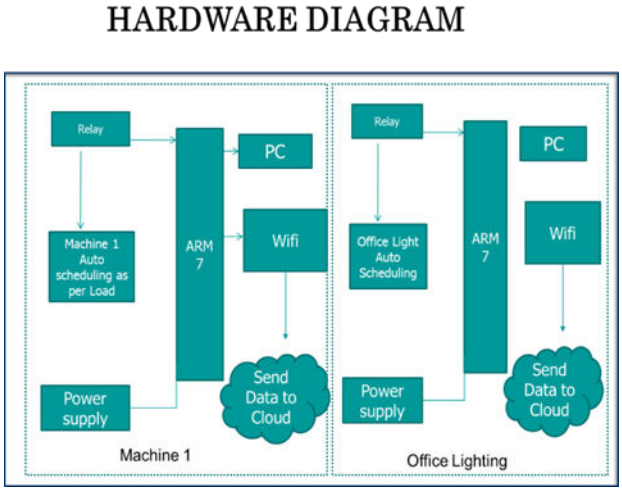


Fig 2. Hardware diagram

Time and end time is for the corresponding venue and takes appropriate actions to switch the devices ON or OFF by activating relay modules. The Real Time Clock (RTC) provides theIoT with the current time. The current sensor senses the current through the appliances and provides input to the IoT, which computes and returns the energy consumption status to the server for data logging and monitoring the venue. To avoid inappropriate switching or allow unscheduled utilization of venue, the automated system control can be overruled by a manual switching. Also the mobile app is developed to access the server, monitor and control the system.The flowchart for controlling appliances is illustrated in Fig.2. The IoT is programmed to receive the timetable from the server in XML format. The IoT derives the current time from the XML file to synchronize the RTC with the server. The IoT then determines the room id, start time and end time for the corresponding venue and takes appropriate actions to switch the devices ON or OFF by activating or deactivating the relays modules respectively. The current sensor senses the current through the appliances and provides input to the IoT. The IoT computes the energy consumption and returns the status to the server both for data logging and monitoring.In hardware side we add ARM 7 core controller which will check status of Industrial loads , and send back data to Firebase cloud for status and manual control .In even of auto scheduling control from app, Cloud send data of ON/ OFF time to ARM 7, and through relay drive circuit it TURN OFF/ and ON loads accordingly to save energy and bring automation in process

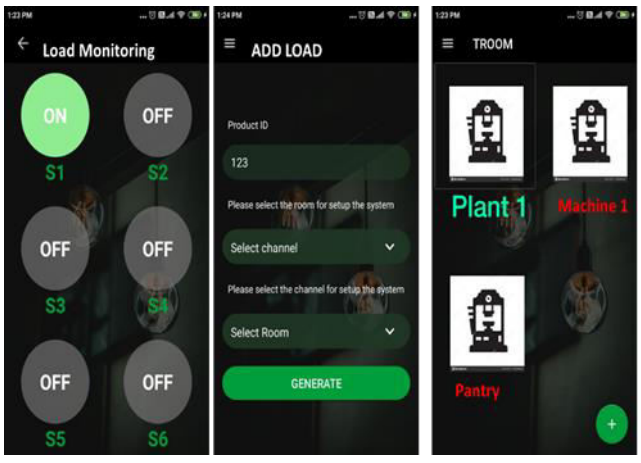
4. EVALUATION AND RESULTS

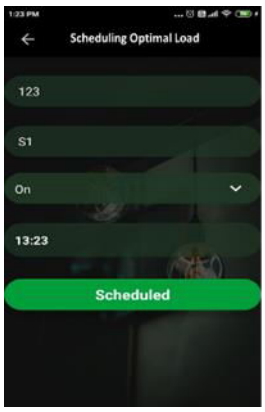
To evaluate the results, two Plants with same load estimateswere used. The energy consumption observation was conducted over a period of 12 weeks that also included a 3 weekDuration break. The energy consumption under normal condition and optimized scheduling were evaluated.
App screen short-

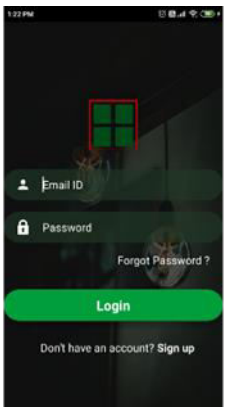
Login Page: In this admin can create industries and add user id and password to access it

Add Load- In this screen we will add number of loads to control

Scheduling Loads- In we will define loads and its scheduling time







A. Energy consumption in normalcondition

The readinginnormalconditionwithrespecttotheloadestimatedwas measured.Theobservedvaluesaretabulatedin Table 2the readings are marginally lower than the estimated values. This could be mainly due to manually switching OFF the appliances when not in use. During the semester breaks the energy consumptiondropsconsiderablycomparedtotheestimatesasthep remisesarebarelyused.

Table 2.WEEKLY READING IN NORMAL CONDITION

Week	Computed load Estimates (kW
1	341
2	341
3	341
4	341
5	341

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B Energy consumption in normal condition vs optimizedscheduling.

1) Comparing the readings in normal condition and optimized scheduling the energy saving is more during the semester and lower during semester break. The normal The cumulative energy saving trend shows that over a long term there is significant benefit. The observation may thus be concluded as follows overall the weekly energy consumption under normal condition was higher than when the scheduling wasapplied.
2) The percentage energy saving was in the range of 26% to 32% and lower than the estimated40%.
3) Thecomputedloadestimatesinnormalconditionorinsch edulingarestaticinnatureanddonot considervariationpattern dynamics of the consumptioncycle.
4) During semester break in week 2, 3 and 4 the energy consumption in normal condition reduced. The percent- age energy saving was in the range of 12% to 14%during this period and the impact due to scheduling waslower.
5) There was small amount of energy consumption even during semester breaks as some devices required to beoperational.
6) The trend shows the cumulative energy saving increases with duration and is beneficial in the longterm.The energy saving varies with the occupancy schedule of the venue. For venues having excessively dense occupancy the energy saving would betrivial

Table 3.WEEKLY CUMULATIVE READING IN NORMAL CONDITION VS OPTIMIZEDSCHEDULING

week	Cumulative reading in normal condition (kW	Cumulative reading after applying optimized scheduling (kW
1	336	227
2	361	248
3	384	268
4	409	290
5	736	515
6	1065	745
7	1404	979
8	1737	1212
9	2069	1459

5. CONCLUSION

The proposed approach exhibited significant energy savingin an Industrial organization by optimization of schedulingbased on the time table of each venue, by automaticallyswitching the energy devices ON and OFF as a result reducingthe energy consumption. In this, the optimization of scheduling may also be carried out using heuristic algorithms such as genetic algorithm and using novel operators of genetic algorithm [11], [12]. Although the energy saving is higherduring the semester, it is lower during semester breaks becauseof reduced utilization in normal condition and if the occupancyschedule of the premises is excessively dense. However, thetrend of cumulative energy saving over long term has significantbenefit. The approach also provided with a mechanism forsmart monitoring of energy devices using IoT and remotelycontrolled by developing an App. Furthermore, this system canbe used for smart estimation of power consumption

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