

The Role Of Automation And Robotics In Buildings For Sustainable Development

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Abstract—This paper gives a simple explanation to the terms automation and robotics. When the term "automation and robotics" are mentioned, what comes to one mind is industrial automation processes which is actual one area where automation and robotics are commonly used. But this study gives us another perspective into the relationship between automation, robotics and sustainable building development. The study highlights certain areas where some particular methodologies for accomplishing certain specific sustainability objectives through the application of automation and robotics. Some of such areas include; Higher Energy Efficiency, Lower Operating and Maintenance Costs, Better Indoor Air Quality and Greater Occupant Comfort and Productivity. All these areas are further discussed in detail.

Keywords—Automation; Robotics; sustainable; building; Development

I. INTRODUCTION

In today's world when we hear the term "automation and robotics", what comes to one mind is industrial automation processes as can be seen in figure 1. Industrial Automation is broadly accepted task carried out by information technology and machines. A ton of enterprises today are discussing automation right now, where a terminology like Business Process Automation (BPA) comes to mind, which is an top-notch technique to smooth-running business forms. BPA includes formalizing all procedures inside the business and after that coordinating them into automation software. Execution of BPA will mean a rebuilding of the whole business [1]. Robotic Process Automation (RPA) is another term used in modern day industries. It has nothing to do with physical robots but instead alludes to "Software robots" which are programmed to utilize computer programs similarly as a human administrator would [2]. They don't really total undertakings in the most productive way, however, they are less demanding to incorporate into the current business forms. Robotization could be completely mechanical or completely virtual, and from being easy to the mind-blowingly intricate. Despite all these there are two broad main types of automation: software automation and industrial automation. Software automation: includes utilizing software to complete jobs which people generally do when they are utilizing using computer programs. While in the case of Industrial automation, it is all about controlling physical

processes. Industrial automation includes utilizing physical machines and control frameworks to computerize assignments in a modern procedure. A complete production line is an extraordinary model, where there are numerous kinds of machine. A case of this kind of machine is a CNC machines common used in the manufacturing industry.

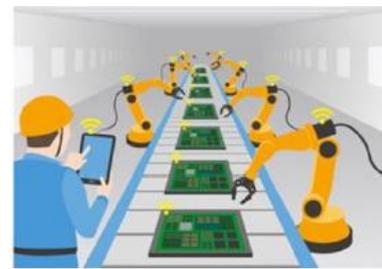


Figure 1: simple industrial automation process

Robotics can as well be understood as a division of engineering which fuses various practice to model, manufacture, and program and utilize automated machines. It is a progressive type of automation that is autonomous or semi-autonomous. Robotics means an element that can manage certain genuine conditions without support [3] [1]. In most cases, they are semi-autonomous as they are guarded or coordinated somehow by a scheme or individual. The term semi-autonomous implies that a machine can make decisions or navigate situations it encounters without help and can as well be controlled. Figure 2 show a simple image of a human robot which can be used for so many applications.



Figure 2: human like Robot

Some notable examples and application as highlighted by [3] includes; an automated assembly line machine packaging peanuts all day long. When a foreign item like an apple appears amongst the peanuts the machine tries to package it. This doesn't

work and the machine goes into an error state and the assembly line stops working and a robot that processes recycling materials can identify 200+ different reusable and recyclable parts. It processes all the scrap metal it is fed into dozens of bins. Although the robot has never seen an apple before, when it is given an apple it is able to pick it up and decide to put it into a bin for exceptional items.

Therefore this paper gives an overview of what is meant by the terms automation and robotization, and points out how automated control systems of building benefit sustainable development by highlighting some particular methodologies for accomplishing certain specific sustainability objectives.

As indicated by the Communication from the Commission on resource effectiveness opportunities in the building department [4] [2] Consumption of assets and related ecological effects all through a building's lifecycle can be decreased by: improved structure and usefulness; ideal asset arranging and vitality proficient product; lessening waste in the development and remodel forms. When we discuss sustainability structures, there is an extensive palette of things that must be viewed, for example, social, cultural, environmental and funding condition. more specifically, there should be measures attributed to construction, materials, energy, assets, and waste [5]. As per a Report case in [6] [4] by the US Department of Energy great productivity and sustainable building ought to be made up of certain criteria. Some of such criteria include: based on our conclusion, the best solution to tackle these challenges.

These paper therefore categorizes some of above mentioned challenge into four major areas where the introduction of robotic, automation and control systems can appreciable provide a sustainable building. The major areas in which building robotics, automation and control systems can benefits in the development of sustainable buildings are

- I. Higher Energy Efficiency
- II. Lower Operating and Maintenance Costs
- III. Better Indoor Air Quality
- IV. Greater Occupant Comfort and Productivity

II. HIGHER ENERGY EFFICIENCY

A couple of control framework forms outstanding importance for energy efficiency. A simple one is efficient occupancy control through such basic practices as occupancy detecting and agendas. Shockingly, numerous bits of tools stay unscheduled, have their calendars abrogated, or are modified mistakenly. While there are no specific numbers, it is, for the most part, assessed that 10-30% energy savings can be accomplished through booked control alone. Include occupancy based booking and more savings can be accomplished.

Another control practice with direct connections to energy proficiency is the thing that has turned out to be known as demand control ventilation. Here, just the

possible best measure of outside air is brought into space by observing return or space CO2 levels and controlling natural air dampers. A lot of cash can be saved by not molding hot summer outside air or cold winter outside air.

On a related note, the right implementation, request based zoning frameworks, for example, VAV and chilled beam, can make a decent arrangement of energy saving. Coupling these methodologies with legitimate static weight control of the supply air, (for example, with VFDs on the fans) results in further energy efficiencies.

Lastly, consider the system that includes resetting the different air stream temperatures, supply water temperatures, and cooling tower condenser temperatures to ideal setpoints as the dynamic load change.

A certified controls provider can execute these and different techniques.

Generally:

i. Automation enhances HVAC effectiveness by strategies, for example, resetting setpoints of boilers as per outside temperature, upgrading begins/stop times for involved periods, utilizing economizers with the expectation of complimentary cooling, and keeping up ventilation at the most proficient flow rates.

ii. Motion sensors permit programmed mishap to abrogate during empty periods just as versatile occupancy scheduling.

iii. Lighting controls decrease pointless artificial lighting by means of movement sensors and timetables just as by controlling sunlight gathering louvers.

iv. A control system preserve water and energy by controlling rainwater harvesting and landscape water irrigation.

III. LOWER OPERATING AND MAINTENANCE COSTS

Definitely one meaning of sustainability could be that we decide on choices now that are proposed to profit, and not hurt, what's to come.

For advance building/framework plan, determination of an automation system dependent on an open transmission custom, and BACnet® specifically, offers future worthy advantages with the end goal that resulting refreshing will dependably prompt interoperable gadgets and frameworks.

As far as building activity, an interoperable control framework can offer to prepare related cooperative energies, along these lines lessening or containing work costs. With diverse frameworks set up, the broadly educating of professionals and administrators can be overwhelming. An interoperable framework, then again, implies that specialists and administrators can learn one front end or administrator workstation while pleasantly dealing with the interoperating frameworks.

What's more, BACnet was worked for the reconciliation of building frameworks. The idea of

reconciliation is fundamental to LEED® confirmed or other green structures. A&E experts discuss a "coordinated structure" and temporary workers talk about "incorporated venture conveyance." Integrated ways to deal with building frameworks can positively affect transportation impressions, on preparing and broadly educating of representatives, and, obviously, on the most effective task of gear. A mix of a scheme can have a specific positive effect on beginning expenses and working spending plans. Also:

i. Trends and logs give data to promote the enhancement of the framework just as for documentation necessities for building accreditation.

ii. Individual room control permits set point alterations just where required.

iii. Based on sensor information, programming cautions and notices ready administration staff to issues before they cause uneasiness to building tenants and grow into greater, all the more exorbitant issues.

iv. Remote arrange observing and investigating through the Internet diminishes administration calls.

v. Sensors with information ports likewise permit brisk system access and control to support staff utilizing a workstation phone a system interface.

vi. Current sensors and power meters screen vitality utilization and electrical age by the breeze turbine as well as photovoltaic exhibits for credit from the service organization.

IV. BETTER INDOOR AIR QUALITY (IAQ)

Will appropriate indoor air quality be accomplished without giving up expenses or solace? The present control frameworks can prompt a very much tuned building where vitality execution, comfort, and economical factors all live amicably. The contrast between a building that does and a building that doesn't is frequently fixing to the structure and establishment of the control framework. That is the place qualifying your controls temporary worker, vitality specialist organization, or framework integrator truly satisfies.

Generally:

i. Temperature and moistness sensors screen warm solace.

ii. Carbon dioxide (CO₂) and carbon monoxide (CO) sensors screen toxins, guaranteeing the required least outside air ventilation.

iii. Control frameworks give smoke control amid a fire, keeping up breathable air zones for clearing.

iv. The control framework screens and controls regular ventilation dampers.

V. GREATER OCCUPANT COMFORT AND PRODUCTIVITY

A control framework can attach building access to the initiation of HVAC and light for a specific space, (for example, an office or zone). This is useful for both individual solace control (a basic for green structures)

just as productive utilization of gear and power. By a similar token, schedules can offer comparative advantages while allowing some abrogate capacity to suit singular needs. At that point, there is drifted or chronicled information which can be utilized to both breakdowns and improve building execution.

Past tenant solace, the control framework likewise has a significant impact on tenant profitability. This fits the more prominent expectation of indoor natural quality as characterized by the LEED rating framework for green structures. For instance, a control framework can screen for CO₂ or different contaminants and start ventilation, alarm, or other corrective exercises.

Specifically:

i. Controllers, in light of sensor input, give ideal zone ventilating, warming, and air conditioning.

ii. Sensors in each room sense temperature and permit occupant controlled set focuses and supersede.

iii. Humidity sensors are utilized to control summer dehumidification and winter humidification of air

CONCLUSION

The application of automation and robotics is not just limited to industrial applications, but also applicable to sustainable building development where energy saving, proper ventilation or indoor air quality, Lower Operating and Maintenance Cost and better occupancy comfort etc. are major objectives for development. This study gave an overview of how automation and robotics would help in achieving all these sustainable development objectives and also highlighted what is meant by the terms automation and robotization, and pointed out how automated control systems and robotization of building benefit sustainable development

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