International Conference on Innovative Research in Engineering, Management and Sciences
International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2019 IJSRCSEIT | Volume 4 | Issue 9 | ISSN : 2456-3307

Efficient Buildings – A Key Element to Build Smart Cities

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ABSTRACT

The use of AI and ML plays a pivotal role in optimizing work flow and productivity and also being cost effective for companies. Artificial intelligence and machine learning can be used to do work that consumes an employee's time that could be used to work productively and focus on higher value work. AI can be used to extract new data and analyze the market for improved business outcomes. It has been statistically proven that using this technology has provided a competitive edge on the business forefront. Security can be heightened and be made safer with the use of fraud detection methods which results in a safer working environment, further providing comfort to the company's employees. Companies will be able to smartly power machinery, vehicles, structures and enhance customer intimacy therefore increasing customer demand. Understanding customer behavior, wants and needs plays a crucial role in what a company's next move should be and this can be improved using artificial intelligence services

Keywords : Smart Cities, Harvesting, Artificial Intelligence, Machine Learning

I. INTRODUCTION

The future of efficient buildings lies in the fields of artificial intelligence and machine learning, both playing a vital role in adding the term "smart" to efficient buildings. The recent expansion of IoT devices and their convergence with cloud-based technologies is making it easier to generate data about building performance – creating a prime opportunity for building owners to apply AI and ML to make critical operational and financial decisions. Employees lose around 1.5 hours a day of productivity due to distractions because they are either thinking about the discomfort instead of focus on the task at hand or may start wasting time on behaviors to cope with their distress. Either way, the problem costs large enterprises or office tenants millions a year in lost productivity. Mobile apps and wearable devices are solving the problem by enabling occupants to connect directly with building operators. Building owners can now directly understand how occupants are using the building and assess their comfort levels through direct tenant feedback. The data collected from these devices can be added as variables to AI to build advanced models of how a building performs to achieve its higher worker productivity which in the long-run results in tenant retention and other benefits for building owners.

II. AUTOMATED POWER FOR EFFICIENT BUILDINGS

Building automation is the process of monitoring and controlling all the systems in a building's which include but are not limited to mechanical systems,

security systems, fire and flood safety systems, heating systems, cooling systems and ventilation systems. The building's occupancy and energy demanded is measured during a small interval of time and the systems in the building are controlled using a centralized system, this system has access to all the systems mentioned above.

III. COMPONENTS OF A BUILDING AUTOMATION SYSTEM

Controllers – are the components that gather the data from the system's sensors (both analog and digital) and determine how the system should respond.

Sensors - The sensors are the devices that collect data throughout your building, from temperatures and humidity, to CO2 output and even room occupancy.

Output Devices - Once the controllers have gathered the data and determined what course of action the system should take, the commands are carried out by the system's output devices, such as the relays and actuators.

Communication Protocols - Communication protocols refer to the language used by the various components of the building automation system to communicate with one another.

User Interface - The user interface is required to interact with the building automation system by monitoring the data reported as well as accessing systems remotely to change settings if desired. The user interface is generally accessible remotely via a mobile device such as a smartphone, tablet or laptop.

IV. BENEFITS OF A BUILDING AUTOMATION SYSTEM

Reduce Building Expenses - Building owners can expect to save a substantial amount of money over the long run with a BAS. Building automation systems especially help save on utility bills, including energy costs.

Improve Comfort and Productivity - By improving the control of the indoor environment, there will be more control over the comfort of the building's occupants. Not only will the building be heated and cooled more effectively and efficiently, air ventilation and quality will improve as well, which is likely to have a big impact on the productivity of employees or students.

Reduce Environmental Footprint - Because a building automation system reduces energy usage, its implementation will immediately make the building more environmentally friendly. By reducing energy consumption, it will reduce the building's output of greenhouse gases. This is one of the reasons air quality will improve.

V. FLOOR PANELS TO GENERATE ELECTRICITY

The piezoelectric effect has been known for more than a century. The concept of piezoelectric flooring is a relatively new concept. A piezoelectric flooring generates and harvests electricity with each footfall. Although this concept is relatively new, it has stirred a great degree of interest in the sustainable energy circles.

Piezoelectric floor panels can be created as an invisible structure that is integrated into the floor. This structure will feature easy maintenance and will be eco-friendly in nature thanks to its recyclable components.

A piezoelectric tile is expected to generate around 4 watts of energy with each step. Around 12 tiles installed at the entrance to West Ham station generated enough energy in the day to power the station lighting by night.

Another concept is that when a person steps on the tiles that constitute a floor, the former flexes by approximately 10 mm, an action which is then converted into around 15 to 25 watts peak. According to engineering.com, the generator used in this innovation is not piezoelectric in nature.

VI. WHAT IS PIEZOELECTRIC EFFECT?

When compressed or tensile stress is induced in a material, an electric field is generated across it, creating a voltage gradient and a current. Piezoelectricity is electrical energy harvested from mechanical pressure such as walking motion. When pressure is applied on an object, a negative charge is created on the expanded side and a positive charge is created on the compressed side. As this pressure is relieved, electric current flows across the substance. Crystals, plastic and ceramics are some of the materials that exhibit the piezoelectric effect.

VII. APPLICATION OF PIEZOELECTRIC FLOORS

Piezoelectric flooring is ideal for places that receive heavy foot traffic. It can be installed at tourist attractions, townhalls, schools, stadiums, or dance floors. In fact, the firm Energy Floors has a product called the Sustainable Dance Floor especially designed for clubs. Piezoelectric flooring can also be installed in other busy places such as subway stations, airports, universities, and malls.

Given that the technology of using floor tiles to generate electricity using mechanical pressure is relatively new, companies in this sector are still looking for venture capitalists and investors. It would also be interesting to see if automotive companies develop an interest in this technology to harvest electricity from the movement of cars and other vehicles.

VIII. RAINWATER HARVESTING FOR SMART BUILDINGS

In a country such as India, where a large source of its income originates from agriculture, one major resource required for the flourishing of said agriculture is the need for water. Another few areas of concern lies with the requirement of water for livestock and human consumption and even for storage of water of rocks on the ground. Rainwater harvesting is collected in the containers before raining down to ground level and collecting it.

In today's modern architecture and infrastructure smart buildings are the talk of the hour. It requires the incorporation of various new technologies, IoT being one such technology. Surcharging of stormwater drains is a problem that is exacerbated by intense rainfall and increasing development. Existing stormwater sewers become overloaded and surcharged, causing localised flooding incidents. If the stormwater discharges to a combined sewer then surcharging causes foul water to flood, which would have health implications as well as the potential to cause damage to property. Rain water harvesting can help reduce flood risk, save energy/carbon emission (at least that associated with the displaced water) and save money.

IX. WHAT IS RAINWATER HARVESTING?

Water is our most precious natural resource and something that most of us take for granted. We are now increasingly becoming aware of the importance of water to our survival and its limited supply.

Rainwater harvesting (RWH) is a simple method by which rainfall is collected for future usage. The collected rainwater may be stored, utilised in different ways or directly used for recharge purposes. With depleting groundwater levels and fluctuating climate conditions, RWH can go a long way to help mitigate these effects. Capturing the rainwater can help recharge local aquifers, reduce urban flooding and most importantly ensure water availability in water-scarce zones.

X. APPLICATIONS OF IOT IN SMART BUILDINGS

One such proposal of is the use of Arduino which provides a number of digital and analog inputs which is used to connect to the computer and for

communicating among systems using a standard protocol. It is highly effective as it is efficient, accurate, cost efficient and easy to use. With the help of an ultra-sonic sensor, stepper motor, water level sensor and the rainwater sensor has been connected along with the Arduino micro controller in order to take readings and take the appropriate measures accurately which could not be achieved by humans due to natural human error. A water sensor can detect water accumulation during the time of rain which can then in turn have a gate opening to the water collection pit. A water level sensor present in the pit can monitor the water levels and once it is filled, with the help of a GSM (Global system for mobile communication) module a water board can be notified thereby closing the pit.

We can conclude from this that Internet of Things (IoT) addresses the network perspective of rainwater harvesting. Peer to peer communication defines future internet addresses of rainwater harvesting. Further monitoring can be done using IR sensors or cameras to detect integrity of the pit and check for faults or damages occurred over time.

XI. REDUCING ENERGY CONSUMPTION IN BUILDINGS

Commercial buildings aren't known for their energy efficiency,MIT researchers have found that as much as 30 percent of commercial building energy is wasted. But the potential energy savings within commercial buildings today are enormous. This is especially true when looking at how much energy is being wasted and how much of that could be reduced by creating smarter buildings. Taking advantage of the latest building automation and building management systems we can reap incredible energy savings in many areas, including HVAC, lighting, as well as operationally.

The major areas of energy consumption in buildings are:

- HVAC (heating, ventilation, and air conditioning)—35%
- Lighting—11%

Thereby by finding methods to reduce the energy consumption of HVAC and lighting, we can reduce the total energy consumption of a building by almost half.

XII. HVAC and Lighting

With HVAC systems and lighting accounting for nearly half of a building's total energy usage, they present two areas where the highest reductions and savings can be achieved, ideally by using a building automation system. Automated controllers help facility managers optimize HVAC efficiency, with temperature and humidity sensors set to optimize heating and cooling systems, and motion and occupancy sensors working with thermostats, lighting, and security.

Machine Learning algorithms can be used to monitor total usage over period and compare against the same time period, by year, month, day or hour. Machine Learning also enables data processing and analysis of all the building (s) data and it is capable of recognizing patterns or anomalies that can lead to insights, savings, and greater efficiencies.

XIII. CONCLUSION

The use of AI and ML plays a pivotal role in optimizing work flow and productivity and also being cost effective for companies. Artificial intelligence and machine learning can be used to do work that consumes an employee's time that could be used to work productively and focus on higher value work. AI can be used to extract new data and analyze the market for improved business outcomes. It has been statistically proven that using this technology has provided a competitive edge on the business forefront. Security can be heightened and be made safer with the use of fraud detection methods which results in a safer working environment, further providing comfort to the company's employees. Companies will be able to smartly power machinery, vehicles, structures and

enhance customer intimacy therefore increasing customer demand. Understanding customer behavior, wants and needs plays a crucial role in what a company's next move should be and this can be improved using artificial intelligence services.

XIV. REFERENCES

[1] https://bosscontrols.com/power-building-automation-system/

[2] https://www.indiawaterportal.org/topics/rainwater-harvesting?page=7

[3] https://cleantechies.com/2015/07/08/piezoelectric-flooring-harvesting-energy-using-footsteps/