

CONSTRUCTION WEARABLE TECHNOLOGY-SMART WORKBOOTS

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ABSTRACT

In the contemporary era every industry is enhancing by using Internet of things, it is one of fear may arise construction industry is left far behind the other industry. That is why construction industry should start utilizing advance technologies offered by IOT to ascertain the smoothness and fastest progress of the construction process. The Internet of Things (IoT) brought on the revolution of wearable, connected devices - yet, for industrial and remote workers these devices are still limited by form factor, battery life, and weight. Managers whose employees are frequently in hazardous and unpredictable environments need an efficient way to monitor the status and location of their employees. This paper clearly discuss how smart work boots will decline construction fatality rates.

Keywords: *Construction Industry, Internet of Things, Smart work boots.*

Introduction

In many countries in the world, the construction industry plays a big role for development process which contributes towards the economic growth that generating additional demands for construction activities. Despite its significant contribution towards economic growth of the country, construction industry has also contributed to large fatality rates due to high number of accidents. Moreover, workers who involved directly in construction activities faced a greater risk of fatality compared to the workers in other industries, as proven by accident statistics.

The causes of accidents in construction industry are related to unique nature of the industry, human behavior, improper site conditions, unsafe work method, equipment and procedures which affected from poor safety management. These causes could result in accidents which further cause disruption of work and decrease the work rate. Therefore, it is crucial for every employer to provide training and the comprehensive safety programs which can improve safety performance continuously to reduce potential hazard in construction project.

The internet of things is allowing for the deployment of easy low-capacity sensors that can communicate cost effectively. IOT makes for every stakeholder to understand what is going on at each stage of the construction procedure in actual period planning to actual construction, post construction a how the building is operated during service. Generally, productivity, security and safety are the main leading drivers of Internet of things adoption in the construction industry.

Death rates in construction industry

The construction sector employed almost 11.2 million people in the united states. High Mortality rates among construction workers remain a global challenge for policy makers. Among all major industries, Construction workers face the highest number of death rates around the world. As per us bureau of labor statistics fatality reports for private construction industry had 1,061 fatality injuries for the year 2019, up 5% from 2018 and the seconds elevated number of worker deaths since the year 2007. In the year 2019 the rate of injuries per 100,000 workers in the construction industry was 9.7, up 2.1% from 9.5 in the year 2018. On the employment fatalities for all construction industries totaled 5,333, representing the disastrous injury ratio of 3.5 for every 100,000 workers.

According to US department of labor report in 2018, 4779 workers die in private industry where 1008(21.1%) deaths recorded in construction industry that is one in five worker deaths. The main reasons for incidents that are happens in the private sector excluding highway collisions in the construction industry were falling from heights (338/1008,33.5%), Struck by objects 112(11.1%), Electrocutions86(8.5%), caught in between vehicles55(5.5%). As per OSHA, 1855 fatality rates are registered in 2015. In 2016, 1963 fatality rates are increased to 1997 by 2018. Therefore, by adopting new technologies like smart work boots we can bring fatality rates zero in construction industry.

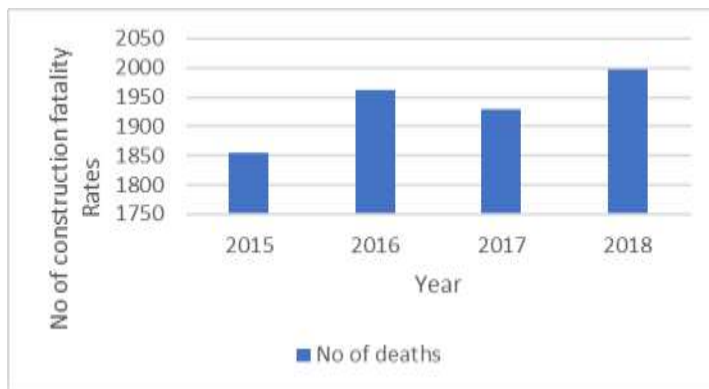


Chart1: Construction death rates form 2015-18 by OSHA

Specifications of work boots

Sole power found a way to harvest kinetic energy in human footsteps. Sole power developed a proprietary sensor platform which is fitted to OSHA- work boots. However, it took 20 versions to achieve a spectrum of features that promotes efficiency and safety. The smart boot is divided into three sections in which heel comprises of 100mw kinetic charger. The smart heel does have a rectangular section and does not break in such a way because it can withhold three times of average human weight. The rectangular segments of the boot heel light up in bright orange after the wearer has taken few steps indicates two things. Firstly, depicts battery is charging.

Secondly, increase the visibility of the person. The charger charges whole suite of sensors placed in the system. The energy generated by kinetic charger will charge couple of plat form of sensors also known as electric board. Electric board has accelerometers which measure motion, temperature, sensors, GPS, Wi-Fi module so it can send data to cloud. Moreover, system of boots estimates the indoor and outdoor position, step count, momentum, time used in work areas and trouble. The complete estimated data will be delivered to a front-end visualization for managers to progress the awareness of the workflow and helps to provide the status of their workforce anywhere in the world.

The middle and front part of boots can place GPS devices (1m accuracy), RFID devices, Wi-Fi module (30metres). Motion sensors things that can give good information about location, motion, weather reports, and uniquely it works solely of the charger. Hence, Sole power created a version of a wearable that you never have to plug it out.



Fig1: Outline view of Sole-Power Work boots

Intellinum is French company which developed and created a “smart & connected safety shoe,” which is used by many industries to provide the awareness for workers about the hazardous conditions or allow the worker wearing the boot to send for help, all with the help of tapping the toe. All the signals and statements are shared by the boot wearer using a derives of MORSE code or by using a smartphone app). The boot is embedded with the vibration motors, a 90dB buzzer, and LED lights which its wearers to communicate with each other at any situation. The boot contains both internal sensor and an external sensor for acknowledging and sending alerts, so if the wearer’s leg or foot is injured, the wearer can use his hand is to reach down the external sensor and activate it.

Safety features like Smart man down is an integrated doubt removal which shoes detect the worker has plunged or is still for too lengthy, then the shoes will vibrate to give the user a way for cancelling the alert. If the user does not answer the alert is automatically sent to the safety team. Smart Panic button is the End-user can send a immediate assistance request to alert their employer or else employer can send a message and make a lot of noise (90 db.) of sound to warn worker about an alert.



Fig2: Outline view of Intellinum work boots

S.NO	Company Name	Specifications	Cost
1)	Solepower	Gps(1mAccuracy),Wifimodule(30M),Altimeter,RFID	250 USD-300USD
2)	Intellinium	Left/Right Vibrating motor, MORSE Code, Cellular Modern LTE-M1 & LTE-NB1 operating between 700MHZ to 2.7GHZ	150USD – 200 USD

Chart2: Comparison between Sole-Power and Intellinium Smart Work Boots

Benefits of Smart work boots in Construction Industry

- Smart boots will enhance workflow transparency and tells sequence of task which to perform in efficient and systematic manner.
- Smart boots give 100 % accountability like amount of duration spent by a worker at workplace.
- It could help lower accident rates on work sites, tracking working hours and determining efficient way of doing job.
- Smart boots track location and motion, providing workforce insights to keep workers safe and alert them when there are in danger.
- It does not matter if it is nighttime, if it is sunny out and if it is raining every time you step its spinning that generator its 10 times more efficient without fatiguing the user than any other type of kinetic charging variable.
- Smart boots can also be applied to many industries like oil and gas, energy, remote surveying, Fire fighters and anybody is off the grid to know the location.
- Working locations, tracking and customized warnings also can provide for safer site excavations and help prevent entry into risky zones.
- Smart boots can also be used to charge portable electronics like cell phones, music players and GPS systems. (Mazhandu, 2019).
- Proximity warning can be given to workers and heavy equipment operators to minimize collisions and injuries.
- Moreover, if a worker enters an area containing known hazards such as slippery surfaces, tripping dangers or steep slopes get alerts from wearable devices can help enhance workplace safety.

Human aspects that contribute to construction accidents

The accidents in the construction sites may lead to a greater loss of both life and property. The following are some of the human factors that are leading to accidents at construction sites. The workers at the construction site need to lift some required objects. During this, some workers may be prone to strain or tear or sprain their muscles by lifting objects that are too heavy to lift. Even the workers knew that the object was too heavy but by not considering it and they tried to lift them. The other common cause of construction accidents is fatigue. This occurs mainly when the workers work continuously without taking any break may lead to make them sick and faint while working. When proper measures are not taken such as by not wearing the safety equipment of the workers when handling hazardous materials is another cause for construction accidents.

Measures that must be taken at the construction projects to reduce the death rates

As it is considered a never-ending battle to prevent construction accidents as it may lead to the death of the people at the construction site. But the death rate due to the accidents at the construction projects can be minimized

by adopting the essential measures. some of these include the following. Maintaining the proper work clothes and the latest gear such as secure helmets, work boots with high performance, protective equipment and so on for all the workers at the construction site leads to providing higher security for the workers from hazards. In construction adopting drone technology and investing more in this technology can be helpful to enhance the higher security for the workers as it leads to conduct the effective survey and to obtain monitor regarding the ongoing activities within the construction project. It is also essential to adopt and follow safety standards. (Department of labor logo unites states department of labor, 2020).

Pros and Cons of smart work boots at the construction sites

The applications of this smart work boot can be obtained in various fields such as in surveying, the oil and gas industry, energy and so on. The pros of smart work boots at the construction site mainly include the following. With its use, the workers can gain 100% accountability. As the smart work boots can provide the tracking of location and progress of the ongoing activities so that all the workers are alerted especially when any danger or hazard is being detected. Higher workplace safety can be ensured for the workers with the use of these smart work boots.

As compared with these numerous pros there are only a few cons that have been identified with the use of these smart work boots. As the work boots are made by using different metals and they can be selected based on the requirements. The work boots which are made from steel are not suitable in hot and freeze weather. Alloy work boots are usually more expensive.

Cost and Maintenance of smart work boots

As the main aim of using smart work boots at the construction site is to provide high security for all the workers to prevent the effect on their life due to construction accidents. As these work boots can be made either using steel or Alloy. The cost may vary depending on the use of the material in the manufacturing of these boots. The Cost of Sole power work boots ranges between 250 USD to 300 USD and Intellinum smart work boots cost vary between 150USD to 200 USD. As maintenance plays a vital role in enhancing the durability of the smart work boots to a greater extent. Such that the work boots must be cleaned regularly and if any dirt or unwanted material is present on the shoes it must be cleaned after completion of the work at the Construction site.

Conclusion

The construction industry has a high number of fatalities and long-term injuries. This is unsatisfactory in a modern society and it also makes the industry inefficient Despite the visions of huge job losses, IoT adoption is uncertain to replace the human in the construction. Instead, it will distort the business models in the industry, reduce valuable errors, decreases worksite injuries, and completes the building operations more efficiently. The best method for construction companies to inaugurate technology is to be accelerating the investment based on areas where internet of things has the most immediate impact as notified by their different needs. The results from the research paper clearly depicts death rates can reduce by using smart boots in workplace area. Moreover security, accountability in workers, transparency in workers, communication among workers, will be enhanced this flatten the curve of construction industry accidents. Finally. Construction companies should adopt new technology and create safety awareness among workers will drive towards success of civil engineering project.

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