WIRELESS/MOBILE SENSORS FOR MONITORING WORKER'S HEALTH AND SAFETY IN CONSTRUCTION

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ABSTRACT: Due to the nature of construction projects, construction workers are constantly exposed to severe weather conditions which affect individual performance while performing duties. In addition, they are exposed to potential work hazards such as vibration, noise, fumes/odors, dust, mists, heavy lifting, working around power tools, or climbing of ladders. This paper presents a wireless/mobile sensor framework: to estimate production efficiency through remote physiological monitoring in all conditions; to suggest effective work schedules according to individual physiological conditions; to propose safety guidelines for tradesmen; and to validate the production efficiency in the construction industry. The physiological conditions of construction workers were collected in various conditions. Work schedules can be adjusted to protect workers from potential dangers and threats according to individual worker's physiological conditions. Relationships between worker's physiological conditions and work conditions can be used to reduce further stress and fatigue which might affect production efficiency. Wireless/mobile sensors can be used to optimize work schedules among tradesmen.

Keywords: *Health Surveillance, Safety Monitoring, Wireless/Mobile Sensors, Physiological Monitoring*

1. INTRODUCTION

It is a well-known fact that the construction industry is a high risk industry with high numbers of fatal and non-fatal accidents. In 2003, construction workers were 7 percent of the U.S. workforce, but suffered 21 percent of the nation's 5,575 reported work-related deaths [1]. Fig. 1 indicates that the construction industry has the highest number of fatal occupational injuries compared to other industries. About 9.7 per 1,000 construction workers fall a victim to fatal work injuries. The total costs of fatal and nonfatal injuries in the construction industry were estimated at $11.5 billion in 2002, accounting for 15 percent of the costs for all private industry [1]. In addition, studies have shown that workers also feel much more stress and fatigue in the construction industry compared to other industries.

This research focuses on: (1) finding feasible solutions to on site health surveillance and safety monitoring; (2) identifying factors affecting workers' health and safety; (3) suggesting trade specific vital charts for preventive actions; and (4) proposing trade-specific work schedule models.

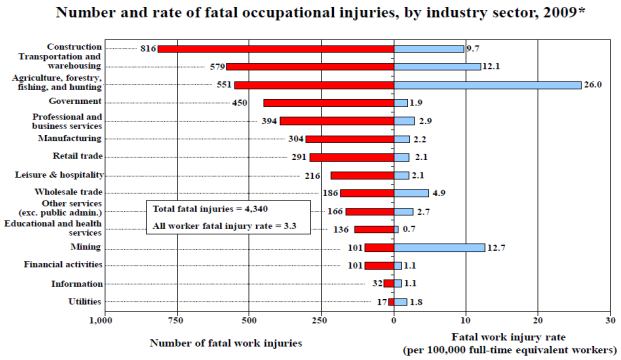

Fig. 1 Source: U.S. Bureau of Labor Statistics, U.S. Department of Labor, 2010 [3]

2. OBJECTIVES

This research is to propose a feasible framework for real-time health surveillance and safety monitoring at construction sites. This research aims at finding:

- A framework for health surveillance that is likely to benefit employers and employees in the industry,
- Valid way to identify factors or conditions with potential health concerns that can occur under particular work conditions,

- An effective way to apply wireless/mobile sensors to construction workers using real-time/live data transmission methods,
- A relationship between a worker's vital signs and job site environment.
- Trade-specific dynamic work schedules for workers which would be based on various factors affecting worker health level.
- Defining worker productivity with health status and work schedule, thereby seeking ways to maximize worker productivity

3. METHODOLOGY AND APPROACH

Real time health vital monitoring is being carried out on construction workers employed by Texas contractors involved in various critical activities such as concrete placement, excavation, reinforcement, masonry, and similar labor intensive tasks as shown in Fig. 2. The physiological monitoring of a worker is done using mobile, wireless sensors. The sensors can be placed around workers' chests and do not hinder their work. The sensors record and transmit instant heart rate, respiration rate, skin temperature, pulse, and instant posture/activity. The USB radio receiver connected to the system receives the data sent by the sensors. The data collected from workers involved in various activities is collected and stored. Once data collection is complete, the data is analyzed using statistical modeling and a trade specific work schedule is proposed.

4. CONFIGURATION OF THE FRAMEWORK

Potential applications include:

- Health surveillance: By constantly monitoring workers' vital signs, contractor can have a medical record and health status of his crew. He can therefore, accordingly manage their activities and durations. It could affect the contractor's Experience Modification Rate (EMR).
- Scheduling: The model developed would equip an owner or contractor with an ideal schedule of workers involved in different trades.

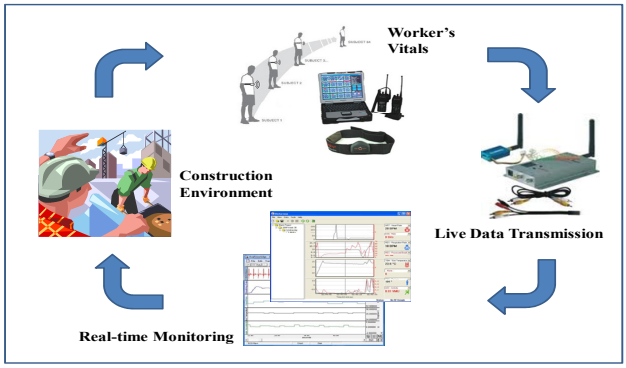

Fig. 2 Framework of Real-Time Health Surveillance Using Bio-sensors

- Crew management: Contractor would be able to manage his crew more efficiently. He would exactly know the work and rest time needed for workers depending on different factors. Hence he can effectively manage crew rotation.
- Increased worker productivity: A regular health surveillance, ideal work schedules and low risks and accidents would definitely have a great impact on workers both mentally and physically. This would lead to their increased productivity.
- Cost Benefit: This model would have both direct and indirect cost benefits. Accident and health related cost would go down. Also, a more effective work schedule would help save time, thus saving dollars. Both the contractor and owner would also save money because of increased worker productivity.

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