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Smart construction safety in road repairing works

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Abstract

Similar to many construction works on sites, road repairing workers often have higher safety risks as compared to other industries in Hong Kong. Some of the careless drivers hit the workers who were repairing road accidentally. Besides, as workers often work under hot sunshine for a couple of hours, some of them have accidents due to poor health and heat stress. In this article, we propose to use Internet of Things, robot / robotic arm to alleviate the problem. It also provides useful information on global popularity of these tools with the help from big data.

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Keywords: Internet of Things, robot, robotic arm, road construction, accidents

1. Introduction

Construction industry records the highest accident rate as compared to other industries in many cities around the globe [1-3]. In recent one month, there was a car accident again when the construction worker was working in the road. He was hit by a van and passed away. It led to a hot discussion on the accidents prevention in road construction / repairing works. Proper real-time safety management is essential from this perspective. Nevertheless, previous research on road construction did not shed light on safety implications, e.g. some only conducted delay analysis by [4-6].

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Nowadays, Smart Work Environments (SWE) are able to monitor activities, workers, tools, and machinery in workplaces, with high potential in improving safety management. By providing infrastructure that interconnects virtual and physical things based on ubiquitous technologies, IoT, it offers a promising opportunity in SWE and cyber physical systems[1]. Besides, as the labor costs are high and manual operations are prone to errors and inaccuracies. Automated solutions based on robots and robotic arms reduce the labour on sites which essentially means that safety on sites can be improved[7]. In this paper, we aim to 1) study the global popularity of IoT, robots and robotic arms in these few years and 2) provide feasible solutions to lower the road construction accidents with the help of IoT, robot and robotic arm.

1.1. Internet of Things

"*The basic idea of IoT is inherent in all kinds of things or objects around us, such as radio-frequency identification (RFID) tags, sensors, actuators, and mobile phones…By addressing unique schemes, IoT systems can interact with each other*" [8].

Whilst the basic internet of things (IoT) includes QR code and RFID where these allow at least two objects communicate with one another. Other types of IoT may encompass the following major characteristics:

i. A set of supporting technologies that is essential to achieve goal of information transition, such as WSN, internet, GPRS ;
ii. The real-time things monitoring via multiple sensors; and the interconnection of smart objects into a global network via extended internet technologies;
iii. An ensemble of intelligent services and applications that leverages these technologies to implement an intelligent control of things [9].

There is an increasing concern of the internet of things in recent year according to the Google searches as shown in Figure 1. Singapore, India and South Korea are top three countries that have the largest number of searches for Internet of Things. In terms of cities with the highest number of searches, two out of three come from India, they are Bangalore, San Jose and Chennai. The results are a bit surprise as developing country like India record the largest number of searches. Yet, when we look at the research of smart home, it is not surprising though: India is one of the countries with the largest number of computer scientists and the number of smart home searches is highest over there[10]. There is a bit surprise though, when we look at the case of the US where the number of searches from there is less than many other countries, the number of mobile IT users and the relative level of computer literacy is not low.

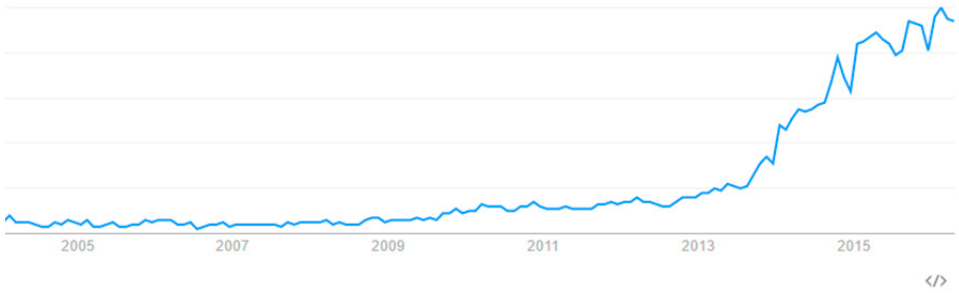

Fig. 1. An increasing trend in Internet of Things from 2004 to April 2016[11]