IoT based-Civil Labour Safety Monitoring System in Construction Site

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Article History: Received: 10 January 2021; Revised: 12 February 2021; Accepted: 27 March 2021; Published online: 20 April 2021

Abstract: In construction sites, many laborers will be working for the completion of the construction project. To monitor these labours, many supervisors were appointed. Since labours are scattered in the field, it will be difficult to monitor them by the supervisors as well as round the clock, they will not be able to monitor whether the labours were wearing safety helmets or not. If it is a high-rise building construction, it will be difficult to locate the labourers at a given time and to communicate any information to them. To protect the workers and prevent accidents in construction sites, a novel design of autonomous system is proposed which monitors, localizes, and warns site laborers which results in saving project time and cost. The designed system is addressing the above said functionalities. The present invention is a low cost integrated system that alerts the supervisor with two signals, one for the helmet usage and another for the idle time of the labour. The labours may not be able to use the existing communication device during the working hours. The present invention alerts the emergency call information from the supervisor. The supervisors receive the location information of the particular labour through this intelligent system if necessary.

Keywords: IoT, Helmet, RFID,PIR sensor, Civil worker safety monitoring

1. Introduction

Technology has been developing faster in recent days. It has become quite easy to get access to relevant information at anytime and anywhere. With smart gadgets users can easily have access to a vast amount of information wherever they are through the use of the internet on these devices. The Internet of Things means interconnection via the internet of computing devices embedded in everyday objects, enabling them to transmit data. Long-term benefits could include energy savings by a platform that controls smart devices and appliances. The most common injuries on the job site are slips, electrocution, and crashes. To fix these issues, IoT is now being used in the construction site Devices and sensors mounted on construction equipment assist managers in tracking and monitoring the fleet's position via GPS, identifying use trends, idle time, and other metrics, avoiding misuse, theft, or fuel pilferage, and effectively planning and scheduling a job based on constantly changing variables on the job site. Wearables that monitor and provide continuous information about the body and health criteria are used by IoT to ensure the safety of construction workers. It sends out warnings when a dangerous/hazardous zone is approaching, and it notifies site managers of any unexpected changes in the local area, allowing them to better manage labour productivity.

2. Related Work

Early in 1995, Jaselskis investigated its potential applications in construction, including concrete processing and handling, cost coding for labour and equipment, and materials control. Since that, a few more studies have been conducted to explore potential applications of RFID in this industry. Jang and Skibniewski (2009) developed an embedded system for tracking construction assets (e.g.materials and equipment) by combining radio and ultrasound signals.Likewise,Goodrum (2006) implemented the technology for tool tracking on construction job sites.Dziadak (2009) developed a model for the 3D location of buried assets based on RFID technology.Domdouzis (2007) explored the applications of RFID in the construction industry including automated tracking of pipe spools and other valued items, and an on-site inspection supportsystem.Tzeng et al. (2008) explored the influence of combination manners of RFID and interior decorating materials on RFID system recognition.Yin et al. (2009) developed a precast production management system using RFID technology in the face that prefabrication is increasingly adopted in construction.Wang (2008) explores how the RFID technology can be used to enhance construction quality inspection and management.Chin et al. (2008) developed an information system to support the logistics and progress management based on this strategy by combining the RFID and 4D CAD.

Smart card using Radio Frequency Identification (RFID) technique to prevent the time delay. In this system, a RFID tag is used to carry the student details and the student needs to show this tag to the RFID reader. Human tracking which uses webcam as a tool where the technology used was Artificial intelligence. RFID Object Tracking in Civil Engineering-RFID technology performance in tracking various objects and constructs tracking knowledge based on literature examination that deals with this issue. Managing Construction Materials with RFID Technology. Materials management in construction is a significant contributor to the success of any project. Some of the common problems faced by construction companies are material shortages, supply delays, waste, damages, fluctuations in price, and a lack of storage space for materials. Research on Safety Management Application of Dangerous Sources in Engineering Construction Based on BIM Technology. At present, the technology of BIM has been gradually applied to various fields of construction projects, providing strong support for the smooth development of construction projects.

3. Proposed System

The system is designed to ensure the safety of Labours, reduce the project cost and prevents the wastage of working time. It is an embedded system ,where we are using the RFID tag to monitor the workers and to prevent them from accidents. This system also focuses on reducing the project cost by calculating the idle time of the labour. Location tracking is done using RFID, which helps in easy communication.

A significant economic objective of this project is to ensure lower costs and save time. The proposed system provides a convenient way of providing the supervisor and labour safety. This system maintains the labour details and it will be used during intimation. It provides an easy way to verify the safety of the labour. It gives an efficient result for the project owner by calculating idle time. These reports provide clear details about the activities of the labour. The data we are storing in a database will also be used for data analytics that gives the frequent intimation and other advantages. At First, the supervisor will send an intimation to communicate with labour and also if the labour tries to remove the helmet the intimation will be sent to the supervisor with the details of the labour. Then an alert message will be sent to the particular labour who is removing the helmet.

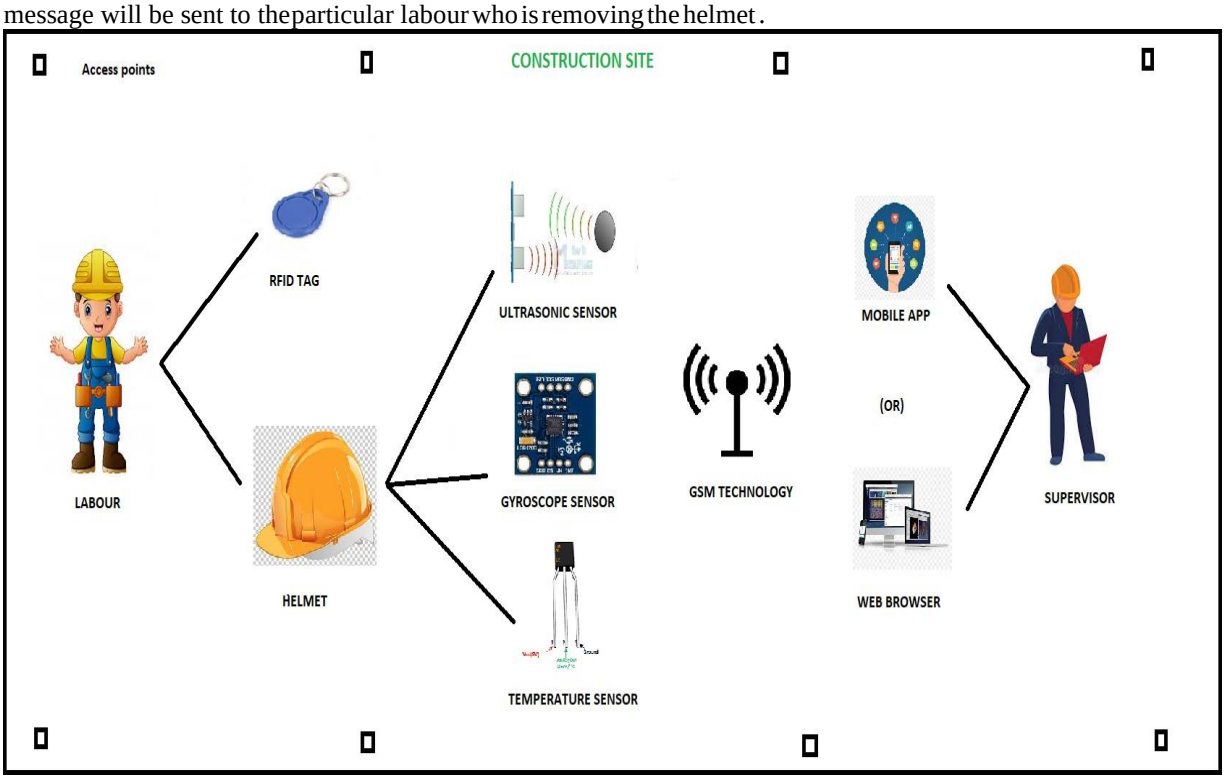


Figure 1.System Model

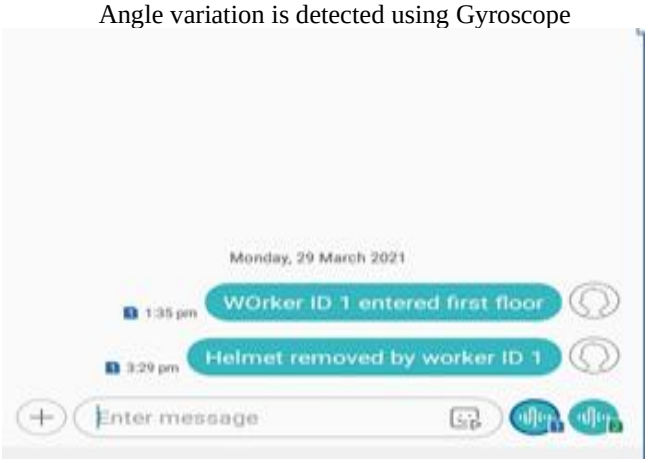
4. Methodology

In order to ensure the safety of labours the helmet is provided with a sensor, which senses and informs the supervisor through alarm if the labour is not wearing the helmet during working hours. This method will comparatively produce low cost with the benefits of sensor monitoring so that the working hours of the labours can be effectively reported through the idle time calculation. Working time of labours can be made effective by calculating the idle time of the labours, as a result of idle time calculation the wastage of working time can be prevented.

Safety Monitoring

To ensure the safety of the labour the helmet is provided with the sensors. Using gyroscope and temperature sensors the angle and temperature variation of the helmet is detected. When the labour tries to remove the helmet an intimation will be sent from supervisor from web browser to RFID tag.

Angle variation is detected using Gyroscope



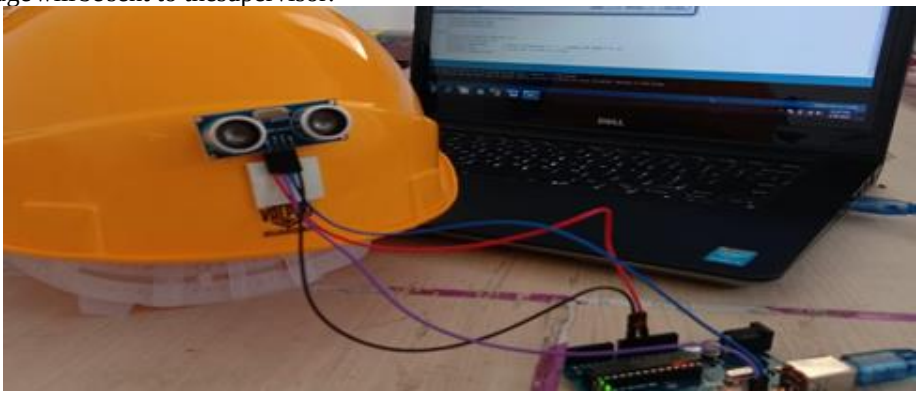
Intimation message is sent to the supervisor

Steps for Safety monitoring:

Step 1: Creating an app for the labour safety monitoring.
Step 2: Check if the labour is trying to remove the helmet.
Step 3: If yes, then send the details of the particular labour to the supervisor.
Step 4: The supervisor selects the labour ID who is trying to remove the helmet.
Step 5: The supervisor will send the alert message to the labour.
Step 6: The alert message is sent to the respective worker.
Step 7: As the labour is continuously monitored, he will not be allowed to remove his helmet.

Idle Time Monitoring

To check the workers idle time, we are using ultrasonic sensors and PIR sensor for detecting the movement of the labour, if there is no movement from the labour then an intimation will be sent to the supervisor that the particular labour is idle.The distance is calculated by the ultrasonic sensor. Allocated time exceeds and motion is not detected, then the worker is declared as idle. For each worker tolerance time 10-15 minutes will be added along with the allocated working time (particular location) in worker Job sheet. The idle time is calculated by using a sensor using the time difference between the start of the work and the movement of the labour. If the labour takes more than the average time to complete a particular task as well as if he is within the assigned working site, an intimation message will be sent to thesupervisor.

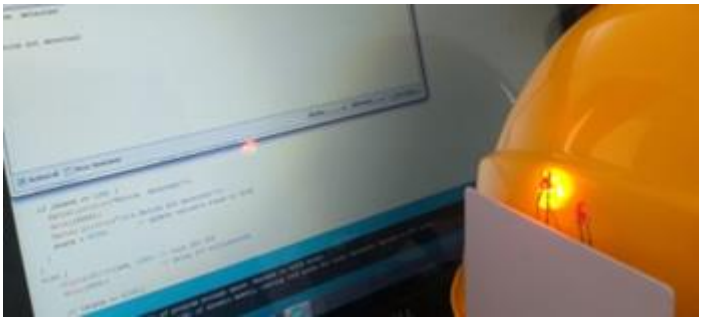


Location Tracking Using Rfid

PIR sensor is used to detect the human entry. RFID reader is placed in every floor of the building which reads the RFID tag from the labour. This is used to find the location of the labour.

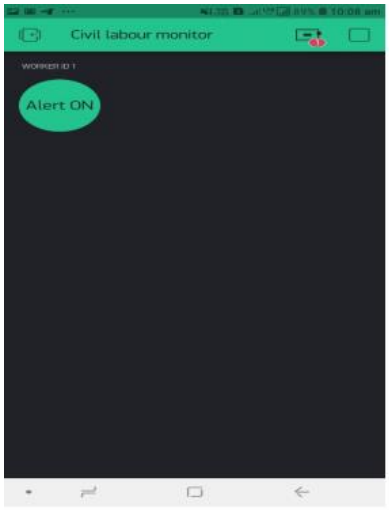
Location indication by RFID tag detect

Hemet removed is detected

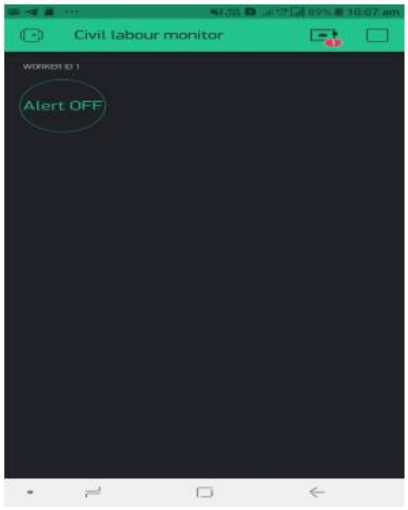


Movement of the labour not detected

Using Blink for sending alert to worker:



Alert on message



Alert off message

5. Conclusion And Future Work

A completed and functioning IoT-Based Civil Labour Safety Monitoring System is discussed in this work. Idle time calculation enhances the efficiency of work in the construction site. This saves the time and the project cost. The detection of helmet wearing ensures the safety of the civil worker. The supervisor and labour interaction is made easier through the sensors.

Using RFID ,PIR sensor and Wi-Fi technology, the location of the civil worker confirms the low cost system for location awareness. A good project can't be produced without proper research. Once enough information was collectedabout prices, strategic components were selected to be a part of the project from both hardware and software perspective. Either web browser or mobile application for the ease of supervisor task is considered as the futuristic task .

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