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Industrial Crane Automation Using Cloud with Artificial Intelligent and Machine Learning

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Abstract: *This paper describes the design and development of a construction crane for use in lifting in the heavy weight object at construction site. The construction crane was developed by automatic system which was modified by adding the* sensors *like proxy sensors, pressure sensors and advance control system. The crane using 3 phase dc motors and voltage range of 220 to 650 volts. The cranes system is controlled through android app using an internet implementing adequate algorithms to ensure a smooth movement and prevent the undesired swinging effects. The machine is operated via a Man Machine Interface (MMI) installed in the android mobile. The range of crane control operations extended by using the internet of things (IOT).*

Keywords: Industrial Crane Automation

I. Introduction

Tower crane is one of the dominant Roles in mechanical equipment of high-rise operation and civil construction for helping with the task of lifting and transporting heavy payloads. The tower crane at work, the mechanisms starting or breaking frequently, crane structure have strong vibration and impact, extremely easy to cause damage, so there is a risk of collapse of the tower crane. At present, the android control of tower crane has become a focus of concern in the industry, the purpose of the study is to find security flaws as soon as possible to eliminate accidents, improve the reliability of the operation. The metal structure is the main skeleton of the crane, its strength and stiffness determines the reliability and safety of the tower crane work. Help the task of lifting and transporting heavy payload. The permanent challenge of building sites require the different activities of the build project it required more skilled workers important to operate the crane safely**.** In addition control parameters are transmitted to the server terminal and the tower cranes controller via wireless controller transmission.

Now a day amount of skilled workers is very less. In crane operator spent in whole shift eight to 12 hours “cabin” about 200 feet in the air. It’s also not a job for those who fear heights. Generally, tower cranes are built in 20- foot section, and there’s a cage ladder that goes from Floor to floor.

The signalers are trained operator eyes and ear on the ground and pass the information to the operator with alternate use of hand signals and wireless communications. The use of signalers reduces the construction efficiency enormously and increases construction cost. The crane cab control box and ground control unit are connected with connecting cable and both wired and wireless control. remote-control operation mode penetrates gradually with irreplaceable advantages.

The wireless controllers are implemented with tablet that was installed software with interactive interface. The bird’s eye view on the operator cab is substituted by the video image on tablet, which is captured by the cameras mounted on tower crane. Additionally, the operator obtains feedback information about tower crane, in another way, “feel” the crane, with accurate sensor measurements which are displayed on the control tablet.

The wireless crane control mechanism is based on the working principle of internet of things. The IOT device is connected to internet and access the crane remote wirelessly the sensors are used to get the accurate output of the current status the camera was capture the image and it give accurate image through the image processing technique. In

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this type of operating system and platform should be created for the industrial construction crane operation. It reduce the crane operators stress was relived.

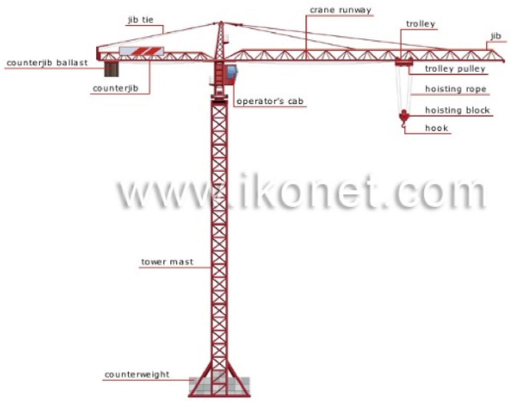
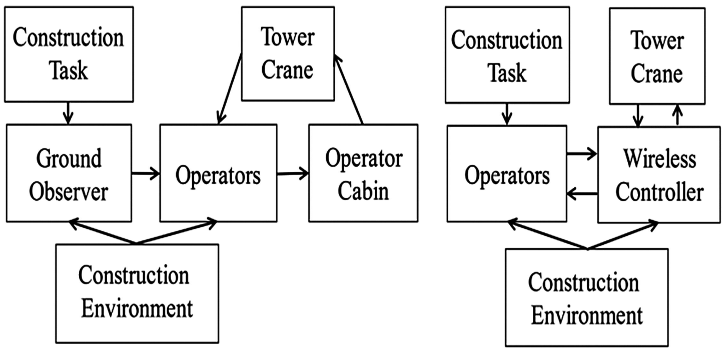


Figure: General structure of the construction crane.

II. Design Methodology

In the construction crane was important equipment play a vital role in construction site the ultimate aim of my paper is design wireless controlled construction crane and it was controlled by mobiles and tablets. It contains the pressure sensors, proxy sensors, IOT device and video camera used in image processing technique. The camera, sensors and controller are connected to the IOT device. The IOT devices are linked with internet. The pressure sensor was patched in the place of hooking section and proxy sensor was attached jib. Other side of the lifting section having the counter weight. The tower crane is connected with up to three control tablets. In this split up control method used to control the various operation of the crane.

The above figure shows that the construction crane .the operator cabin was located in the 200- foot above the ground surface. The counter jib ballast was used in the construction crane for counter weight.



(a) (b)

Figure: Block diagrams of (a) the conventional tower crane and (b) the wireless-control tower crane.

A tower crane is connected with three wireless controllers, which increases communication between the operators and the tower crane. Tower crane in construction plays an important role for hoisting and transporting building materials. Every crane operation is initially broken down to two segments fast-travel part of the operation (the hook's fast motion throughout most of the travel path) and fine-maneuvering part of the operation (the hook's slow motion during the landing process, namely the slowing approach of the hook to the pick-up/drop-off point).

Six types of sensor were applied for measuring the real-time status of tower, jib and trolley. Taking tower crane, the actual assembled positions of sensors are pointed out as well. Two displacement sensors are used to measure the horizontal and vertical position of the object. An angle sensor was used to measure the angle of the jib. The load sensor is used to measure the loading weight of object. The wind speed and tilt sensors are involved as well.

Sensor network and data transmission of safety management system for tower crane groups (SMS-TC). ACC-Anti-Collision Controller RSP, Remote Supervision Platform. LMT-Local Monitoring Terminal. TC-STE, Tower Crane Safety Terminal Equipment.

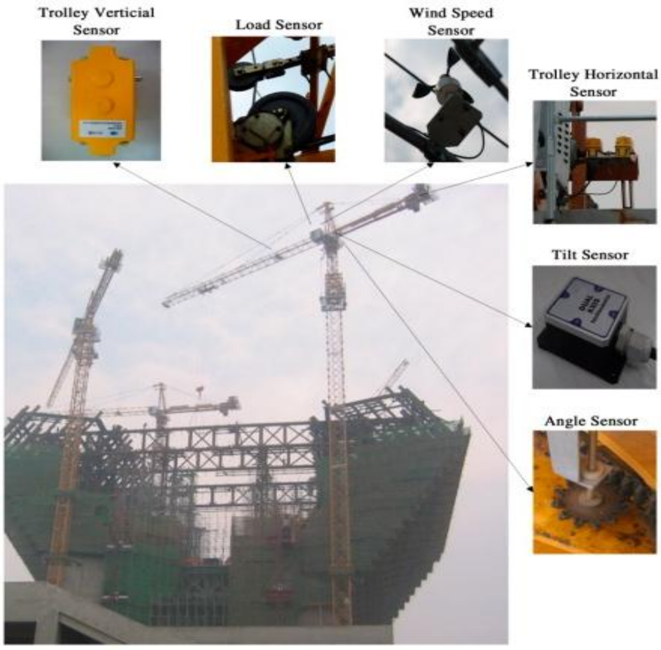


Figure: Crane and its parts

In order to detect the Operating Status of each tower crane and its trolley, five sensors were employed and directly connected to TC-STE via a short wired signal line. In order to detect the Operating Status of each tower crane and its trolley, five sensors were employed and directly connected to TC-STE via a short wired signal line. They are the horizontal and vertical displacement sensors for the trolley, the angle sensor for jib, and the load , tilt and wind speed sensors for the tower, respectively. The wireless signal can guarantee the stability of high-speed transmission for the raw data obtained from these sensors efficient manner. ACC was integrated in TC-STE was process the raw sensor data. Only processed raw data were transmitted to the LMT via the short wireless zigbee network.

The RSP belongs to the Application Layer of the IOT and Part 3 of the Network Layer. RSP is an essential component of our system SMS-TC. In addition, RSP is the key component to make SMS-TC is a meaningful practical IOT application. Technically supported by dedicated data server, the official supervisors can only login the RSP via the Internet to approve and register a certain tower crane before construction. During construction, they can give high gain of the real-time and historical status information of a every individual tower crane in their area of the jurisdiction. After construction, they can obtain a details and statistical data report of the entire project.

III. Lifting Capacity

Crane lift settings are stored in the database along with their associated gross capacities. These lifting capacities are compared with the total lifting weights (G’), including the equipment weight (GL), sling weight (GSL), spreader weight (GSP), and hook weight (GH). The values of these weights are from the database or interface. The crane’s lifting capacity associated with any given configuration should be greater than or equal to the total lift weight in order to satisfy Eq.1

$$G \geq G' \quad (1)$$

Where $$G' = G_L + G_{SL} + G_{SP} + G_H \quad (2)$$

Formula for weight lifting

1. Rectangle/Square:

Volume = Length x Width x Height

2. Hollow Cylinder:

Volume = 3.14x Length x Wall Thickness x (Diameter – Wall Thickness)

3. Steel Pipe:

Volume = 3.14 x Length x Wall Thickness X (Diameter – Wall Thickness)

Volume = 3.14 X 8 feet x 1.5 inches x (3 feet – 1.5 inches)

Convert inches to feet (1.5 inches = 0.125 feet)

Volume = 3.14 x 8 feet x 0.125 feet x (3 feet – 0.125 feet)

Volume = 3.14 x 8 feet x 0.125 feet x 2.875 feet

Volume = 9.03 cubic feet

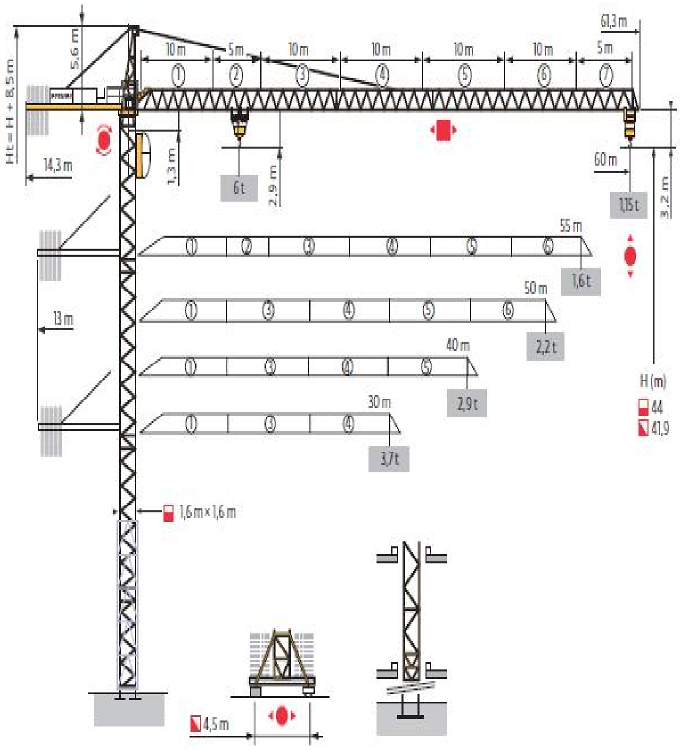


Figure: Graphical Representation of the Distance vs Weight Lifting Range

In crane system at the end of the crane it lifting the small amount weight due to the balance of the crane structure. In case of the near of the jib it lifting the high range of the weight.

IV. Conclusion

This paper presents the man-machine interaction that implemented with proposed wireless controlled crane system for construction crane. Crane is one of the dominant Roles in mechanical equipment of high-rise operation and civil construction for helping with the task of lifting and transporting heavy payloads. The crane automation is important for developing countries. The wireless controllers are implemented with tablet that was installed software with interactive interface. The pressure sensors, proxy sensors, IOT device and video camera used in image processing technique. The camera, sensors and controller are connected to the IOT device. The existed crane was the operator. In future the development of machine learning and the cloud computing of the system.

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