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Trends in robotics and automation in construction

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ABSTRACT: *In India, the construction industry is one of the largest industrial sectors. The construction industry plays to enhance the overall national economy of the India, the complaints of poor construction quality have long been traditional Problems in the India construction industry. For successful quality work, such as lack of skilled workers, poorly installed equipment, poor platns,etc among this in an increase in the real cost of construction & labour. These facts, together with the rapid advancement in automation and robotics technology indicate promising potential for gradual use of automation in construction industry. Studying recent application and projects for using robots and automation in the construction industry. The paper mentions the benefits of automation and robotics technologies application during construction, execution and in brief gathers the factors that form barriers to more substantial use of the technologies in the sites.*

Keywords: *Construction site, construction work, construction industry, Computer-integrated construction (CIC), fixed construction automation, programmable construction automation*.

I. INTRODUCTION

Until very recently, the construction industry was one of the most unfamiliar to research & development fields for the robotics and automation community, despite the fact that this industry is one of the oldest and represents the largest economic sectors. Today the Indian population is getting educated, thus labour intensive jobs have very few takers and the trend will worsen with the disparity in the income decreasing with the future generation opting for higher education. The technological level of the construction industry during the old ages was very high for their historical period. The old civilizations have built very long lasting structures like pyramids, acropolis, aqueducts, cathedrals, Taj-Mahal etc. They used innovative processes and elements for their contemporary normal building procedures. Nevertheless, some of Nowadays construction processes have changed little. The old days pulleys are substituted by cranes. At times construction work is conducted under dangerous condition and situation, thus there is need for robotics to optimize equipment operation improve safety and quality of work

Automation can be done in uniform brick laying, plastering of uniform thickness of ceilings, interior & exterior walls. Automation can provide reduced labour dependability higher output and increased productivity, less variability, reduced human errors, greater control & consistency, safe working environment, flexibility etc.

Construction phase is one of the important aspects of civil engineering structures. The success of a project depends on how well the construction phase is carried out. Efficient and economical construction is particularly important because of the increasing complexity of structures being built, the availability of improved materials and construction equipment. Typically in manufacturing field, robots are stationary and product moves along the assembly line. Automation is easier to incorporate because each product is identical with respective tasks done

over and over. However, construction robots face with different demands than conventional industrial robots. They must move about the site, because buildings are stationary and of a large size. . Certain work in the industry is tedious and monotonous. Such work could be carried out by programmable machines having memory to carry out repetitive jobs. Feedback system using microcontroller and

A/D and D/A converter could be used. Although certain work like compacting & leveling is carried out manually till date, in many areas of the world, could be carried out perfectly by using automated machines having programmable comparator. Additionally, they are constantly exposed to dust and dirt on the site. Thus, there is a need to develop a robotic system for full-scale experimentation for realistic assessment of automation in the construction industry.

Automation can be done in following areas

Roads & Runways construction
Structures
Buildings construction
Ports
Tunnels
Factories and industries

From the above aspects we are going to discuss about automation on the following Equipments

1.1Laser Receiver

1.1.1 To Carry out the grade and slope control with the laser receiver.

1.1.2Working: The grade is determined by receiving laser beams. The use of fur bola laser receiver is particularly suitable for paving large areas with constant longitudinal and transverse gradient such as stadium, car parking's, storage sites etc. The rotating lays generated plain with rotating laser beams. This plain is detected by laser receiver mounted on the screed arm this laser generated plain serves as an artificial references i.e. the independently base condition ideally the paver operated within 200 meters radius to achieve optimum measuring results. One special advantage of laser receiver to position the high up the paver. It is mounting height is 4.5m and sores the measurement are not interrupted by other job site vehicles crossing its path before paving commences the receiver and rotating laser have to be brought into the position. The laser can easily precisely align with the led display for instance the downwards pointing arrow display. This indicates the beam receives two low by the receiver and has to be elevated. The displayed horizontal dash displays indicates the laser beam is central or optimization relationship to the receiver. The laser receiver can be quickly calibrated while operation.

1.1.3Principle of operation: The plane formed by the rotating laser and rotating laser beam is recorded by the laser and rotating laser beam is recorded by the laser receiver on the paver and Serves as reference as grade slope control. The receiver leaves the plain and great deviation is determined as sent to the automated control system. The necrotic system control the screed toe point ground so the screed moves correct position thanks to the large measuring range ±11cm the laser receiver can also used on undulating bases without height of rotating laser constantly have to be readjusted .The tolerance range sensor is extremely precise that ± 1mm

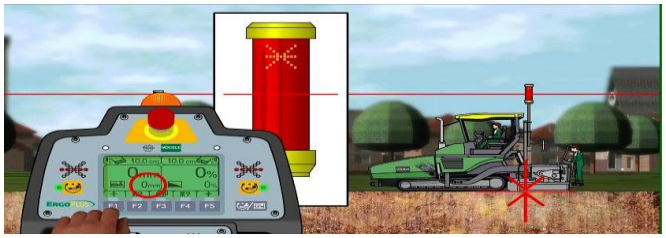

Figure No 1.1.3

1.1.4Field of application

The laser can be combined with various sensors to control the other screed sized for most devised application. For instance a slip sensor is frequently used to generate a transverse gradient to the pavement once more all available grade sensors can be used such as a second receiver. The references plain generated laser can be tilted both in the transverse and longitudinal axis. This function can also be used for paved areas to slope to drain off water. Measurement of screed elevation by rotating laser. Even the paving regardless of base condition. Even for paving large areas.

1.2 Concrete Batching Plant:

Recent advancement in automation technology has given rise to the automated control of plant, which is termed as SCADA (Supervisory Control and Data Acquisition). In this, the plant is controlled through the PLC using the automation software. The operator has to feed the recipes of the Mix for the particular grade of concrete mix. The SCADA automatically guides the plant System to take measured quantities of raw materials like Cement, Sand, Coarse Aggregates, water, and Add Mixture in to the mixer and mixes it to the pre defined time. These raw materials will be weighed through the load cells and discharges only to the required amount of material for the particular mix and batch. After mixing for the defined time, Mixer gate will automatically open and concrete will be discharged to the Transit Mixer.

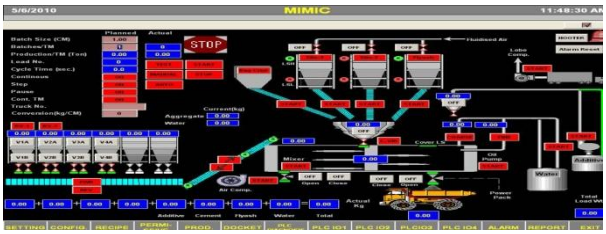

Figure No 1.2

The advantages of using (Supervisory Control and Data Acquisition) SCADA:-

1) It over comes the scarcity of skilled labour.
2) Quality of the concrete mix is achieved.
3) As we are using the digital technologies, more accuracy of the mix is achieved
4) More productive compared to manual operation. In automation, parallel activities take place.
5) It is economical to use the systems in large scale production.

1.3Paver technologies:

Principle: Automated machine 3D control system includes the Navitronic automatic control system into the 3rd dimension in addition to the grade control. Automated machine make's it possible to control widths and paving directions on the basis of digital planning data. Nowadays the use of 3d control system such as laser, total station, GPS, is common in moving the earth. However the requirements on precision for grader and dozers are considerably lower for asphalt pavers. After all the paving of surfaces subjected to rigid tolerances in mm range especially when it comes to thickness. Automated machine is currently the only 3d control system that can fulfill the high requirements. Automated machine comes on open port, meaning on an open interface. Various Positioning system from different well known numerous manufacturing's can be connected to this interface. The benefit is that, many sub system are already available to

1.3.1Construction: The use of Navitronic system paver is equipped with the new electronic system. Automated machine comprises a no of components. The central Navitronic unit, this is connected to Navitronic system which exchanges the control data. A mast from mounted 3D receiver a slope sensor determining a transverse gradient of a screed two directional sensors to determining current screed width depending upon the positioning system is used; either laser total station or a GPS system is connected to the Automated machine system This means Automated machine can also be used on 2D control system on wheel pavers. As a sizing factor controls gradient determine the current elevation and the slope of the screed and when necessary we able to correct this by just screed toe point brands. The screed elevation can be determined by a receiver the positing by the exact height of width or constantly tracked by a total construction firms and this can now be used to control the asphalt paver. also be used to determine the transverse gradient But the gradient slope shows the Automated machine display. . The combination of measuring data namely the paver position, steering direction, screed width its elevation, slopes allows the automated machine system to control paving to an accuracy of 1mm at every point along the planned route.

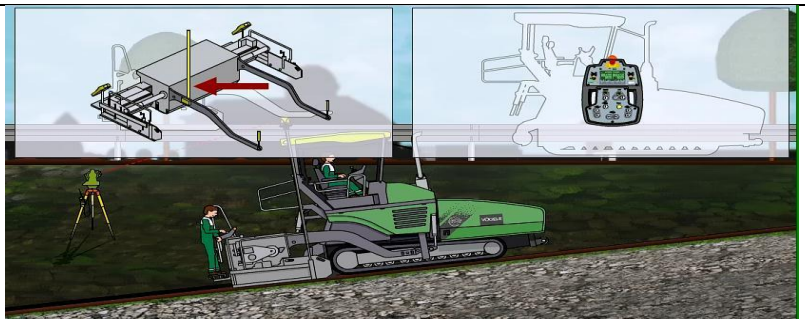

Figure No; 1.3.1

Automated machine system brings decisive

Advantages of conventional sense technology especially for larger projects. Existing planning data can be used to control the pave, time and cost intensive tensioning of wires can be dispensed with in comparison as approximate cost of 2500-3000 Rs/- can be assumed per kilometer of tensioned wired, work can be carried out without reference zone edge of the root which could be an interface. Using Automated machine system boosted productivity in large projects extensive road constructive projects are completed in shorter time at lesser cost and road can be opened to traffic sooner. Digital pavement design data can be used for precise control of the paver and screed. The following parameters can be monitored and controlled steering of paver, width of screed grade, slope. Open port for connecting various 3D systems.

1.4 Bar Straightening and cutting machine:

Today the steel bar cutting and straightening done manually and standard of 12 meters are taken and from those bars of the required length is cut, thus the remaining scrap is generated due to end length be discarded. This could be avoided by taking coils of torque steel in the specific diameter and could be done in automated straightening cutting machine, which straightens and cuts to the Requisite length, there by saving the end cuts and drastically reducing the scrap generated

Figure No 1.4

1.4.1Principle: Nowadays construction industry is more emphasizing on cost savings and reduction in wastage. In traditional methods the TMT steel used in structures has to come in Standard lengths, where to achieving the no of TMT steel bars required is a challenged. e.g. standard length of TMT bars is 12 meters, if we require 5 meter bars, then 2 meters will be under wastage. To overcome this wastage issue, bar straightening and cutting machine comes into Picture. In this the coil of steel ranging from 6mm to 16mm weighing about 1.5 to 2 tons will be fed to this machine, which straightens the bars and simultaneously cuts the TMT steel to required lengths with the speed of 130m/min and above. With the use of this machine, only one operator is required to operate this machine. Thus in turn decreasing the skilled labour by 70% to 75%.

1.5Kerb Machine:

Kerb machine is used in construction of roads. In this kerb machine the complete system works on the closed loop feedback system robotics. The inputs are fed to the machine using the reference string line. This string line is mounted as per the required grade and curvature of the kerb. Both grade and steering (Curvature) inputs are given on the same string line creating the reference line for the required kerb to be laid. Both steering and grade sensors of the kerb machine are fed to this string line. As the machine advances, if the sensor senses any changes in the reference line, accordingly it gives the signal to the controller, this controller proportionally feeds to hydraulic system to raise/or lower the height of the mould.

The steering function also works in the same fashion as the grade does. If the steering sensor senses any changes in the reference string line compared to the preset value, accordingly the controller directs the hydraulic system to direct the steering as much as required until the sensor attains the equilibrium.

II. CONCLUSIONS

In this paper the focus is on automation of robots specializing in construction & machine automation. The stress is on integration of computer, IT, microprocessor & mechanical equipment's keeping in the mind the needs of the construction industry .Through automation we can replace workers and put automatic machines, reducing casualty. Dust generated from construction industry often lead to fatal diseases like tuberculosis and other bronchial problems thus effecting the man hours and hampering work. In such places automation could go a long way in increasing productivity & safety of the engineers and workers involved. The use of technology would rather be able to convert the labour oriented industry into a highly mechanized & precise industry with uniformity in the Construction process and reducing cost of the project. It can also greatly reduce the scrap generated and thereby reducing cost. Reusing building material could enhance environmental friendly conditions and can lead to green construction. In order to rapidly advance in research and development and reach the consolidation period the ideas discussed in the previous section need to be adopted and especially new national & international research programs have to be established.

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