Constructor Bot-Autonomous Building Material Delivery in Local Construction Sites

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***Abstract*— An autonomous building material delivery which can be used in local construction sites is proposed and implemented in this article. The proposed methodology consists of two robots: A manual robot (a pick and place robot) and an autonomous robot (line follower robot with delivery mechanism). The need for two robots is that the autonomous robot can be at the end of any of the stories in the building and the manual robot uses the crane in the construction to reach that storey. Then the manual robot can pick and place any building material on the autonomous robot. The autonomous robot which is based on line following traces the line and delivers the building material. The autonomous robot uses auto-updating of memory and path traversal algorithms to traverse through the line. The end zone can be thus identified with the help of line tracing. This methodology reduces human labor for loading and unloading materials. So that the poor people working in the construction sites are free from injuries and stresses. This in turn also reduces the cost paid by the construction companies for the injured people. Thus human work and intervention will be reduced leading to safe construction environment.**

***Keywords*— Building materials; Construction sites; Autonomous robot; Manual robot**.

I. INTRODUCTION

The construction sites in local areas around villages employ labor for cheap payment. The labors working inside these sites are almost taken no care on their health and safety. This sometimes occur when there is need of transportation of heavy materials within these sites such as carrying bricks in their head or passing these materials from one person to the other. Such risk factors results in injuries for the poor labor people and the construction suffers from paying compromise cash for the victims. Therefore a replacement must be needed in order to prevent poor people getting injured. There are a large number of robots available for picking and placing heavy materials in industries, may be even many tons of loads. These costly equipments are available in industries and construction sites present in cities. These equipments cannot be purchased by the construction sites present in villages and they cannot be handled by them. So, simple design equipment which suits the environment must be built. Electronically operated robots are therefore used which have a low cost design and simplicity in mechanism. As there will be placement of construction materials in the ground floor, the robot must be able to pick and place it up, carry and deliver it to the different working zones. A single robot cannot handle the whole task of loading and unloading from the place of stack in the ground floor to different parts in the building (including various other floors).

This, in turn, necessitates the use of two robots- a manual robot and an autonomous robot. The manual robot is manually operated in the ground floor either by a switch (wired control) or remote (wireless control). When manually operated the robot can be moved near the block of building materials and it can pick and place the materials and hold it for a certain time and it is operated to move near the crane (which is kept at the construction sites as an elevator to reach different floors). When this robot reaches a certain floor with its materials it identifies its neighbor and places the material on the top of autonomous robot. The autonomous robot identifies the object with the help of sensor and traces the line and delivers the load to different zones within the construction site. This methodology reduces the need of human intervention for loading and unloading heavy materials. Detailed illustrations and implementation of the methodology are given in the next sections.

II. PROPOSED METHODOLOGY

The proposed methodology mainly emphasizes on the reduction of the work of labors for lifting the materials using robots and also its delivery. The manual robot uses the switch control mechanism and the autonomous robot consists of micro-controller control. Fig 1(a) shows the block diagram of the manual robot.

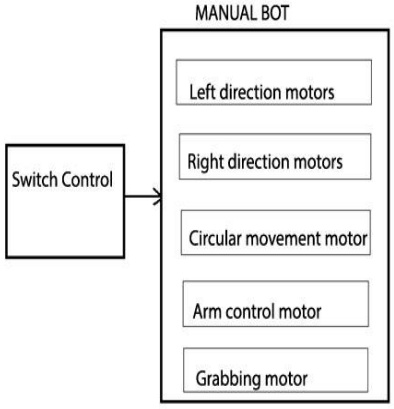

Fig.1 (a) Block Diagram of Manual Robot

The block diagram of the autonomous robot is shown in Fig 1(b).

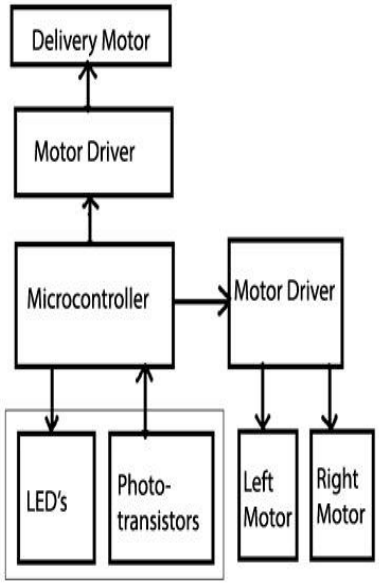

Fig.1 (b) Block Diagram of Autonomous Robot

The block diagram of the manual robot symbolizes that the robot movement is done using wired switch control. The implication of a wired switch is that it can be operated easily and the switches are directly connected to motors. So, there will be an immediate action of the control. The robot picks and places the building material with the help of the robotic arm. The arm movement control is activated by using Double Pole Double Throw (DPDT) switches.

The block diagram of the autonomous robot implies that the robot is a line tracer with microcontroller as the center of control. The Arduino Uno board which uses the Atmega-328 Microcontroller is used as the control. The line tracing Infra-red (IR) sensor is interfaced with the arduino, which consists of a Light emitting diode (LED) and photo-transistors. The light from the LED is reflected by the black line and received by the photo-transistor. This phenomenon is used to follow the black line. It senses the line and give control signals to the arduino.

The arduino drives the motors used for movement with the help of the motor driver. An H-Bridge circuit is used for driving the motors. The L293D Board consists of the H-bridge circuit to drive the motors. The output from these drivers is given to the motors and hence the movement is controlled. The programming using Arduino Software is very simple such that any changes can be made immediately. The delay can also be programmed for the entire movement. Addition of algorithms make the autonomous robot very effective in the way to decide on its own way related to the path inside the sites.

III. DESIGNED MODEL

The designed model constitutes the operation for weighting some useful materials inside the construction sites. Fig 2 (a) and 2 (b) are the designed robotic models for this purpose.

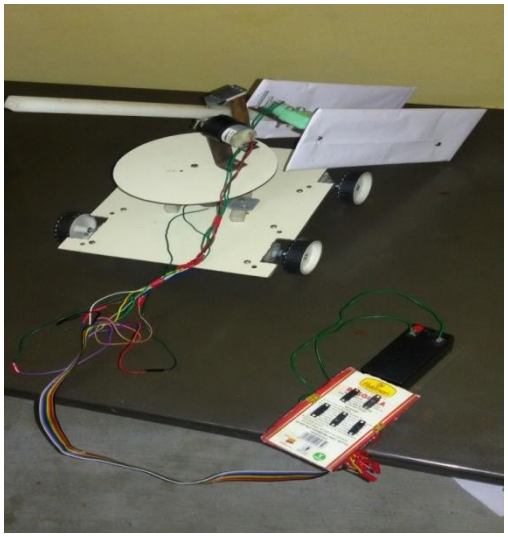

Fig.2 (a) Designed Manual Robot

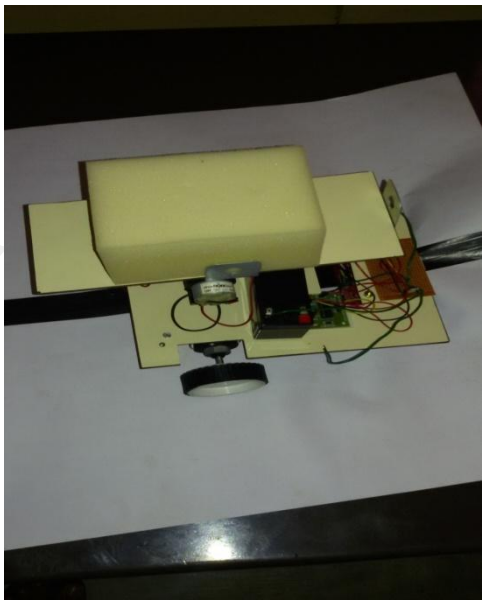

Fig.2 (b) Designed Autonomous Robot

The manual robot consists of an arm controlled by dc motors for picking and placing the building materials on the autonomous robot. The dc motors also provide the necessary torque for handling the materials of certain weight.

The autonomous robot consists of delivery mechanism supported by a dc motor for delivering the building materials within the environment. This robot senses the line and makes the movement. It has IR sensor module for line detection and a pair of IR sensors for object detection.

IV. RESULT AND DISCUSSION

An electronic robot replacement for human in the local construction sites at risky work situations is implemented in this article.

A manually operated robot (pick and place robot using switch control) and an autonomous robot (line following robot) is designed so that with the help of two robots, loading and unloading of building materials is done. These two robots can be used as a replacement for the human in spite of risking their life in the construction sites and it also increase the time efficiency. The designed robots deal only in picking and placing construction materials in a desired location. This may minimize the human intervention for loading and unloading the materials within those sites.

This type of robots can be used for human replacement in risky areas. In some sites child labor are employed for very low cost. It can be used as a replacement for child labor also. Without the help of the manual robot, autonomous robot can function. If any object is kept over the autonomous robot it senses the object and starts tracing the line. This is very helpful in avoiding misjudgments. The purpose of autonomous robot may be also extended to deliver goods in warehouses and households and also for serving in hotels and hospitals.

The replacement of robots in such areas can minimize the hazardous situations of people getting injured during transportation of materials within the sites. The robotic hardware is designed initially to lift a brick and place it on the other robot and finally to the destination. By including a little hardware, many materials of heavy weight can be lifted and delivered across those areas. By extending some lifting mechanism of the delivery arm in the autonomous robot, it covers various applications such as serving robots. Regarding the future scope, industrial management and maintenance can be done through these robots. In hotels and hospitals line following robots can be employed to serve people. Many human work replacing robots are implemented in the present situation in many foreign countries. Implementing such a type of robots in our country can increase the standard of the country as a developed nation.

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