PpAVER: PAVER PLACING AUTOMATIC VEHICLE EMBEDDED ROBOT

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ABSTRACT

In the modern era, the laying of the interlocking tiles by cleaning the plot, adding layers of gravel and smoothening, then laying the tiles by human hands need huge time and efficient works by the laborers, which can be quite difficult if unable to find the workers at a fixed time. This PpAVER investigates the potential for automation of the work of masonry. An automatic PAVER placing robot was designed and its criteria for design were such that it should be able to lay the interlocking tiles automatically. This PpAVER designs the consideration for the whole process of implementation of the robot from the input and its management to the construction process by the robot itself. The main motivation for the research is the need to reduce human fatigue installation time, cost, and maintaining consistent quality. This is a major cause for the development of society although huge changes are witnessed by the construction industries nowadays. This paper investigates the potential for automation of masonry work. This interlocking tile robot was designed and the robot design criteria were such that it should be able to place the tile automatically. The design included the functioning of the interlocking tile-laying robot head.

KEYWORDS: ARDUINO MEGA, DC MOTORS, L239D, KEYPAD, LCD DISPLAY

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INTRODUCTION

One of the main challenges the construction field faces is low productivity compared to other areas. There are many problems the construction fields face nowadays. Labor efficiency is low and works quality and control are insufficient, which results in a high accident rate onsite. Also, the huge time consumption of the laborers makes the work more complicated. Although the laying of the interlocking tiles can be done by the human masonry efficiently the struggles the people undertake to make them available on the plot is the main issue, which we need to be eradicated. This project eradicates this problem by automatically laying the interlocking tiles. The lack of the laborers is the main issue faced by not only the construction industries but also by the majority of the people who prefer a finished work of pavers, replacing the human work by the automated machines can do the work efficiently. This will reduce the huge time consumption caused by the effort of the people to find laborers and the time spent on that can be reduced.

Problem Statement

The laying of the interlocking bricks is complex and it requires huge time. The lack of availability of labor is another main disadvantage since the required time is high the expense will increase, due to the usage of low-quality raw materials the base of the foundation will not be strong this leads to cracking of interlocking bricks and also they will not be stable. Referring is another problem in which the base will get separated from the bricks due to that bricks will get sunk.

Solution Proposed

This paver placing robot places the interlocking bricks automatically which reduces the complexity by reducing time consumption. Therefore speed increases gradually, Accurate measurement and proper placing of bricks will make the base strong and avoid the occurrence of error. The bricks will not sink since they are stable. The lack of laborers and the huge time caused due to the masonry work can be reduced by implementing the automated system for the interlocking tile laying. Our project PpAVER is an automatic interlocking tile-laying robot, the microcontroller is the heart of the system, microcontrollers along with the motors and the L293D module, and the LCD module.

LITERATURE REVIEW

Industries are facing a lot of problems nowadays due to the lack of laborers and the big-time caused due to their work on the site. This can be eradicated if the interlocking tile-laying can be done automatically. Our project PpAVER is a paver placing automatic vehicle embedded robot which will play the interlocking tiles automatically. It works with the help of the pair of rack and pinion principle, in which the rack moves along with the movement of the pinion. First, the robot will have a forward movement and lay the tile in the straight line and then the pinion rotates to the left followed by the movement of the rack towards the left and then the robot will have the backward movement along the straight line.

Overview of Existing Model

First, the robot will have a forward movement and lay the tile within the line and then the pinion rotates to the left followed by the movement of the rack towards the left then the robot will have the backward movement along the line. The present situation clearly highlights the necessity for automation within the construction sectors. So as a part of the literature survey, we explored various related projects. Here are a number of them [1]. Other Research projects focused on a particular design problem of the automation process. For example, (King, Bechthold, Kane, and Michalatos(2014) explored the automation of tile placement employing a style of mathematical algorithms and image-based methods. Their discussion led to the conclusion that installation costs for both robotic and manual placements are similar, but robotic methods add customization within the possible patterns. Bock, Stricker, Fliedner, and Huynh focused on the software as part of the paver laying robot design.[2]Those cited research projects focused on the “functional” aspects: placement, pattern recognition, software, etc... However, the look of a part of the robot isn't provided and detailed in the literature. For SAM100, the look relies on an articulated arm as found in previous research projects (Bock et al., 1996; Pritschow, Dalacker, Kurz, & Gaenssle, 1996). The articulated arm supported by a truck-crane robot.[3].In this article, we explore a unique design alternative for the brick-laying robot. The design could greatly impact the efficiency of the robot and its cost. This text provides insights on the importance of the look phase when building a robot intended for construction.

DESIGN AND DEVELOPMENT

From our analysis of the market and competition, most of the product, market, and organizational development goals will be readily apparent. This PpAVER investigates the potential for automation of the work of masonry. An automatic paver laying robot is designed and it's criteria for design were such that it should be able to lay the interlocking tiles automatically. In this approach, companies will lower prices and make brick pavers work easier.

Figure 1: Block Diagram.

Arduinoboard is an open-source microcontroller board that is based on Atmega 2560 microcontroller. These boards are used to extend separate interactive objects otherwise we can connect to software on your PC like MaxMSP, Processing, and Flash. L293D is a typical Motor driver or Motor Driver IC which allows DC motors to drive in both directions. L293D is a 16-pin IC that can control a set of two DC motors simultaneously in any direction.

L293d is the major part to rotate the dc motor, where the motor is attached to wheels of the robot. The dc motor will control two DC motors with a single L293D IC. Keypads are used in all types of devices, including mobile phones, calculators, microwaves, ovens, door locks, bank lockers, etc. The 4x4 matrix keypad is used here, the matrix is a small compact device that accepts user input and is processed by microcontroller. The 4x4 matrix has 16 builtin push button contacts connected to rows and columns lines. A microcontroller can use these lines for a button pressed state. Lots of electronic devices are used for user input. A liquid crystal display or LCD gets its definition from its name itself. It will display the content that we type in the keypad. LCD uses a liquid crystal to produce the content on the screen. A DC motor will operate according to the L293d. One L293d can rotate 2 dc motors. The opposite polarity between the two magnetic fields inside the motor causes it to turn. The dc motor is the major part of this project. The motor helps to rotate the wheel of the robot. There are four motors in this, two motors, used to rotate the wheels of the robot, one wheel to rotate rack and pinion setup, and another motor to rotate the conveyor belt to rotate and place the tile in the correct position.

Figure 2: 2D Model.

CIRCUIT EXPERIMENTATION

Our project PpAVER is placing an automatic vehicle embedded robot which will lay the interlocking tiles automatically. It consists of 4 dc motors and L293d, keypad, LCD display. It works with the help of the pair of rack and pinion principle, in which the rack moves along with the movement of the pinion.

Figure 3: Circuit Diagram.

There are four wheels in the robot, for forwarding and backward movement, then a rack and pinion setup for side movement. In the robot, we attached a box where we kept the bricks, which contains 20 to 25 bricks. There is a keypad where we enter the length and breadth, by the program, we calculate the area. In the keypad, we manually enter the length and breadth. There is an LCD display where we can see the enter length and breadth and calculated area. First, the robot will have a forward movement and lay the tile in the straight line, and then the pinion rotates to the left followed by the movement of the rack towards the left, and then the robot will have the backward movement along the straight line, the tiles are placed. There is a box that carries the interlocking tiles.

RESULT AND DISCUSSION

The proposed device was successful in achieving its outcome as a safety device for laying the interlocking tiles. Its future scope with more advanced technology is still under consideration but the initial prototype is good enough in achieving its prime motive. Throughout the process of the testing, the prototype demonstrated consistent and repeatable functionality from the mechanical subsystem. In making repairs and adjustments, it was noticed that a better battery system could provide more advantages to its design consideration to its weight and size. It works with the help of the pair of rack and pinion principle, in which the rack moves along with the movement of the pinion. The components we have used here are the L293D module, servo motors, LCD module, ARDUINOMEGA2560 as the microcontroller. The interlocking tiles are being laid appropriately in the plot as per the requirement. Although a huge number of tiles could not be carried simultaneously, it will carry approximately 20 to 25 bricks. While the economics of such automation is revealed, future research should focus more on the fully automated interlocking tile-laying robot on-site work conditions.

CONCLUSIONS AND FUTURE SCOPE

The PpAVER that had been designed had almost reached the desired design. The PpAVER was designed to lay and fix tiles efficiently and accurately. We have completed the programming section and lathe work of the PpAVER. In the beginning, we decided to make use of the pick and place robot. Later, we came to know that it is an existing model. Finally, we came to the idea of a conveyor belt to lay the bricks and a rack and pinion in order to move the machine forward and backward. While laying the tiles, it didn't get laid properly to the ground. Thus, a slider was placed from the end of the conveyor belt with a box at its end for the proper laying of tiles. We have constructed the PpAVER in such a way that the conveyor belt can carry and lay block tiles of any dimension.

In the future, designing a few improvements in the existing robot can increase efficiency. Some of the improvements to be made in robots are as follows. This robot is only laying the interlocking, later we can extend for further purposes. Another important thing we can add an additional feature that we can use this for another shape now this model is for the square shape we can extend for more shapes. During the placing of brick, some amount of force has to be applied on the brick so that it should strongly form a bond with sand. There is another added feature that we can add that the smoothing of the gravel, and the place we were placing the interlocking tiles, will not be uniform so we can smooth the area. Lots of additional features we can add. In this project a small area can be covered by this robot, in the future, we can extend to cover a large area. Nowadays tarring is replaced by interlocking tiles inroads, so there is a huge application in this area. Interlocking tile robots have a huge scope in coming generations.

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