DESIGN AND FABRICATION OF LADDER CLIMBING LOAD CARRYING ROBOT

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Abstract-A robot is generally an electro-mechanical device that is guided by using laptop and digital programming. Many robots were built for production purpose and may be found in factories round the arena. Designing of the cutting-edge inverted ROBOT which may be controlling using an APP for android mobile. And in which we use Bluetooth conversation to interface Arduino UNO and android. Arduino can be interfaced to the Bluetooth module although UART protocol. According to instructions received from android the robotic motion may be managed. The constant output of a robot device alongside pleasant and repeatability are unmatched. This robots may be reprogrammable and may be interchanged to provide a couple of packages. Robotic system having palms this is appropriate of motion in choppy surfaces as well as climbing ladders. Ladder hiking is an vital mode of locomotion for navigating business environments and carrying out preservation tasks in homes, bushes and other man-made systems. The motion of robot is mapped with the aid of hand moves. An arduino board is used to control the wi-fi manage whole operation. It collects facts from the controller and sends it to the robot (wireless conversation). The final product is an self-reliant robotic this is able to climb the ladder efficiently. Main Frame, Rack, Pinions, Arms, MS Angle Guides, Threaded rods, Nylon Rollers with a bearing variety 6201Z, Motor Support flat plates with drilled holes, D.C. High Torque Motors, Remote, Receiver, Battery, Battery Charger, Main Frame product of Mild Steel, Wiring.

Keyword: autonomous robot, Arduino UNO, Rack, Pinions, Arms, Bluetooth wireless communication.

1. INTRODUCTION

Robotics is the branch of era that offers with the design, creation, operation, and alertness of robots, as well as pc structures for their control, sensory comments, and facts processing. These technology cope with automated machines that can take the area of humans in dangerous environments or production processes, or resemble people in look, behavior, and/or cognition. Many of today's robots are inspired via nature contributing to the sphere of bio-inspired robotics. Many robots do jobs which are unsafe to people inclusive of diffusing bombs, exploring mines and shipwrecks. Ladders are found in our guy-made environments. They are designed to help human beings to bridge vertical distances without difficulty. However, this man-made structure poses a extreme challenge to vehicles and robots Thus, so as for robots to operate effectively and efficiently in city environments; this challenge must be addressed. Autonomous ladder mountain climbing robot has been the situation of ongoing studies inside the last few years. Most of the robots use best leg-like mechanism [1, 2], while a number of them use track mechanism [3]. The predominant drawback of those mechanisms is that we can't manipulate the rate, inclination, and even if errors occur we cannot accurate it at that immediately. As a result, a hybrid design is proposed right here. The robotic can circulate speedy on flat surfaces and limb like mechanism is used to climb up and down ladders. It can climb ladders which can be higher than the robot.

FIG.1   FIG.2

Fig.1 & fig.2. Risk of falling & injuries

2. LIETRECHER REVIEW

A ladder is a vertical or willing set of rungs or steps. There are types: inflexible ladders which can be self-assisting or that may be leaned in opposition to a vertical floor along with a wall, and rollable ladders, which include the ones made from rope or aluminum that may be hung from the top. The vertical participants of a rigid ladder are referred to as stringers o rails (US) or stiles (UK).

Rigid ladders are typically portable, however a few kinds are permanently fixed to a shape, building, or system. They are typically manufactured from metal, wood, or fiberglass, however they have been regarded to be manufactured from tough plastic.

2.1 TYPES OF LADDERS

Accommodation ladder is portable steps down the side of a ship for boarding.

Assault ladder, used in siege battle to help in hiking walls and crossing moats.

Attic ladder, pulled down from the ceiling to allow access to an attic or loft.

Bridge ladder, a ladder laid horizontally to act as a passage among two points separated by means of a drop.

Boarding ladder, a ladder use to climb onto a vehicle. May be inflexible or flexible, additionally boarding step(s), and swim ladder

Cat ladder (US chicken ladder), a light-weight ladder frame used on steep roofs to prevent people from sliding.

Christmas tree ladder, a type of boarding ladder for divers which has a unmarried central rail and is open at the perimeters to permit the diver to climb the ladder whilst wearing swim fins.

Counterbalanced ladder, a set ladder with a lower sliding part. A system of counterweights is used to permit the decrease sliding element descend lightly whilst launched.

Extension ladder or "telescopic ladder", a fixed ladder divided into two or extra lengths for extra convenient garage; the lengths can be slid collectively for garage or slid aside to extend the length of the ladder; a pulley device may be geared up so that the ladder may be effortlessly extended by an operator at the floor then locked in area the use of the puppies and pawls. Sixty five ft (20 m), 50 feet (15 m) and some 35 toes (10 m) extension ladders for fire provider use "bangor poles", "tormentor poles" or "stay poles" to help enhance, pivot, constant, amplify, location, retract and lower them due to the heavy weight.

Fixed ladder, aspect individuals joined through numerous rungs; affixed to shape and not using a transferring parts.

Folding ladder, a ladder inside the step ladder style with one or extra (typically no more than 3) one-way hinges. Ideal to be used on uneven ground (e.G. Stairs), as a trestle or whilst absolutely extended a fixed ladder. Some versions characteristic a principal one-manner hinge with extensible locking legs.

Hook ladder or pompier ladder, a rigid ladder with a hook at the pinnacle to grip a windowsill; used by firefighters.

Mobile Safety Steps are self-supporting structures that have wheels or castors making them easy to move. They from time to time have a small upper platform and a hand rail to help in moving up and down the stairs.

Orchard ladder, a three legged step ladder with the 0.33 leg made so that it can be inserted among tree branches for fruit picking.

Platform ladder, a step ladder with a large platform area and a top handrail for the person to keep even as operating on the platform.

Retractable ladder, a ladder that looks as if a drainpipe however may be deployed instantly when required.

Roof ladder, a rigid ladder with a massive hook on the top to grip the ridge of a pitched roof.

Sectional ladder, additionally called a builder's ladder, has sections that come apart and are interchangeable so that any number of sections can be linked.

3. EXPERIMENTAL OR MATERIALS AND METHODS ALGORITHMS

- Initially fingers connected with the body will preserve the ladder by way of rotating +ninety Deg.
- Pinion on body will rotate to ascend the rack to next degree of ladder, once the rack pinnacle reaches subsequent degree of ladder, pinion will forestall rotating.
- Arm hooked up on top quit of the rack will hold the ladder with the aid of rotating +90 Deg.
- Now arms attached with the frame will release ladder by rotating -ninety Deg.
- Pinion at the frame will rotate in reverse path to descend the rack. However the top give up of the arm is held at next degree of ladder the frame may be dragged to the following level of ladder.
- Once body reaches next level palms attached with the body will keep the ladder through rotating +90 Deg and Arm mounted on pinnacle of the rack will release ladder with the aid of rotating -ninety Deg.
- The procedure will continue till the preferred stage of ladder is reached.
- In this project ladder hiking system is completed by means of movement of rack and conserving fingers.
- Pinions and hands used in this task are driven via container kind excessive torque geared DC motors.
- Rack is guided via MS guides on each the edges to keep away from side wise motion.
- Entire operation is executed via using faraway manipulate.
- Battery set up on the body will strength the drive vehicles connected to arms and pinions.

4. Adriano Controlling System

The Arduino Uno has some of facilities for speaking with a computer, any other Arduino, or other microcontrollers. The ATmega328 provide UART TTL (5V) serial communique, that is available on virtual pins zero (RX) and 1 (TX). A Software Serial library lets in for serial conversation on any of the Uno's virtual pins. The ATmega328 also help I2C (TWI) and SPI communication. The Arduino software consists of a Wire library to simplify use of the I2C bus.

Fig: 4.3 Arduino Uno

4.1 Bluetooth Module

Arduino-Uno board doesn't aid Bluetooth connection on its personal, which makes the idea of connecting it wirelessly to an Android device not possible. So a medium among the Arduino-uno board and android device is wanted and on this project it's far a Bluetooth module specifically the HC-05 Bluetooth module. The HC-05 is a user pleasant need handiest basic understanding and it's far programmable the use of the AT commands.

Fig: Bluetooth Module

4.2 Software Implementation

The programming operation become carried out via C language the usage of arduino IDE. Every software had its unique function. The Arduino language is merely a set of C/C++ capabilities that may be referred to as from your code. Your sketch undergoes minor modifications (e.G. computerized era of feature prototypes) after which is passed without delay to a C/C++ compiler.

4.3 Motor Driver L298

The drive circuitry for an H-Bridge is essentially the electronics that sits between the PWM (and potentially different) digital manipulate inputs and the MOSFET gates. It has essential purposes:

- ➢ Translate the enter voltages to suitable ranges to drive the gates.
- ➢ Provide sufficient cutting-edge to price and discharge the gates speedy sufficient [4]

Fig: 4.5 l293d

4.4 D.C. Motors

A DC motor is any of a category of rotary electrical machines that converts direct modern electric strength into mechanical electricity.

The maximum not unusual types rely on the forces produced by magnetic fields.

Nearly all styles of DC automobiles have some inner mechanism, both electromechanical and digital; to periodically trade the direction of contemporary go with the flow in part of the motor.

DC automobiles have been the primary shape of motor widely used, as they could be powered from existing direct-modern-day lighting fixtures electricity distribution structures.
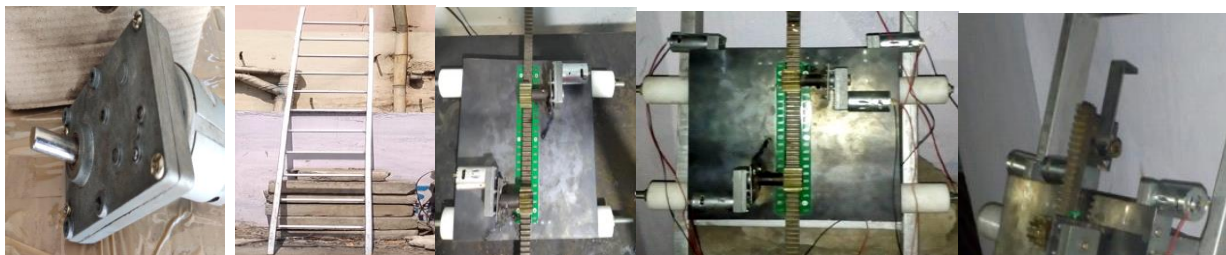

Fig.4.6. Box type high torque geared dc motors

Fig 4.13 finished ladder

Fig 4.19 view of rack & pinion with in the guide ways on main frame

Fig4.34 view of nylon rollers on robot

Fig 4.37 view of upper arm on robot

4.5 Motor Shaft Coupling

These are used as intermediate element between the palms and the motor in addition to to keep the pinion gear on its grew to become element on one side. Grub screw is outfitted into the threading to arrest the movement of this shaft on motor shaft and match tightly, so motion is supplied for the cease elements including arms & pinion tools.

| Fig 4.41 | fig 4.42 | fig 4.43 |

Figures. 46, 47, 48. Pinion gear & cylindrical shaft arrangement

4.6 Calculations

Motor power calculation for pinion

- mass of robot   = 10 kg

- mass to be ascended by each pinion   = 5 kg

- radius of pinion (r)   = 0.0127m

- force (f)   = m x g   = 5 x 9.81 = 49.05 n

- torque (t)   = r x f   = 0.0127 x 49.05

                                                 = 0.62 n-m

- speed of motor (n)   = 10 rpm.

- power   = 2 x 3.14 x 10 x 0.62/60

                                                  = 0.62 w

- maximum power required is 12.83w and selected motor power rating is 30w which is higher than required.

Top holding (upper) arm calculation

- mass of robot   = 10 kg

- mass acting on holding arm   = 10 kg

- radius of arm (r)   = 0.125m

- force (f)   = m x g   = 10 x 9.81 = 98.1 n

- torque (t)   = r x f   = 0.125 x 98.1 = 12.26 n-m

- speed of motor (n)   = 10 rpm.

- power   = (2 x 3.14 x 10 x 12.26)/60
= 12.83 w

Side holding (lower) arm calculation

• mass of robot   = 10 kg

• mass acting on each holding arm   = 5 kg

• radius of arm (r)   = 0.125m

• force (f)   = m x g   = 5 x 9.81 = 49.05 n

• torque (t)   = r x f   = 0.125 x 49.05

                                                           = 6.13 n-m

• speed of motor n   = 10 rpm.

• power   = 2 x 3.14 x 10 x 6.13/60

                                                           = 6.42 w

4.7 Results and discussion performance analysis
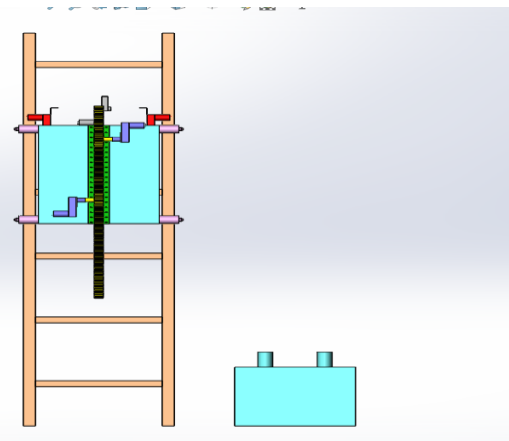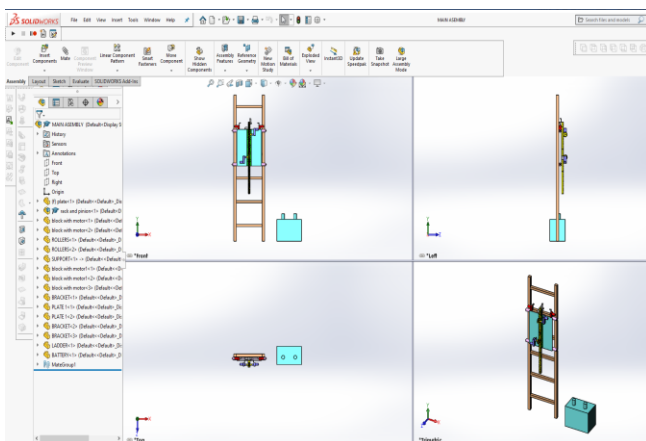
5. Conclusions

Here a robotic gadget having 3 palms which is able to motion in choppy surfaces as well as hiking ladders is mentioned.. This gadget has two parts: the controller part and the robot component. We make use of arduino board to govern the complete operation. The motion of the robot is mapped through hand movements. It has the ability to lessen human work to a extraordinary quantity. It is designed to transport in both vertical in addition to horizontal directions. It uses a zigbee transmitter module and receiver module for transmission from primary controller part and reception via robotic part for ideal mapping. It is like minded with any model of ladder. The operation is absolutely user controlled and therefore errors charge is minimal. The heavy battery drainage and incapacity to hold heavy masses are the important drawbacks. Power saving ought to be taken to consideration in subsequent levels. As the wide variety of sensors boom the mapping of movement of arms grow to be less difficult. More quantity of sensors can be introduced. High energy servomotors may be used to boom the weight wearing ability.

➢   Selected automobiles are delivering required torque for ladder mountaineering operation. Pinions, side palms and top arm motors are able to take reverse torque without failing.

➢   Present design lets in us for diverse widths and periods of ladders.

➤ Robot is capable of ascend and descend on ladder without any slippage.

➤ Provided on board battery helped warding off external wiring.

➤ Robot is examined for ascending and descending the usage of far off control.

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