

Tetrapod Automaton in the Shamble's Management with the Fish Eye Lens Pi Cam

B.Meenakshi, R Sivaprasad, R Sowndarya, R Srinithi, K Thejaswini



Abstract: Automation Is The Future Technology, Without This Most Of The Technologies Are Implausible. This Paper Is All About The Tetrapod Robot Which Is The Four Legged Robot That Could Be Used In The Shamble's Management Application. This Robot Has Four Legs For Kinesis. The Motion Of The Legs Is Achieved By The Concept Of Inverse Kinematics. The Servo Motors Are Making The Bot To Drive. The Arduino UNO Is Used To Send Signals. It Has PC (Inter Integrated Circuits) Interface. It Has Two Signals. They Are Serial Clock Line Signal And Serial Data Line For Master Slave Communication. The Main Motive Of This Bot Is To Make It Walk Under The Disaster Areas Where Human Intervention Is Challenging. It Takes Live Images And Streams Video In The Disaster Areas. The Image Capturing And Video Streaming Is Achieved Using Raspberry Pi Fisheye Lens Camera Module. It Provides A Slight Image Difference In The Field Of View Compared To The Usage Of Normal Lens. The Resolution Of This Camera Is 5megapixels. The Advantage Of Using This Bot Is For Implementing It Under Impossible Human Intervention. It Moves In Any Bleak Surfaces Which The Maneuvered Robot Cannot Get The Stability. The Legged Robot Gets Its Stability Due To The Arrangement Of Legs With The Chassis Taking The Center Of Gravity Into Consideration.

Keywords — Inverse Kinematics, Inter Integrated circuits, Fisheye Lens camera, legged robot.

I. INTRODUCTION

Among all the bionic robot applications, Tetrapod robots are the most analyzed and researched and they constitute utmost priority among various branches of Robotics. In 1968, a four legged walking machine was built by General Electrics and the US Army Mobility Systems Laboratory using hydraulic server motors to drive [1]. After few years it was found and postulated that for achieving very high value of controllable degrees of freedom, proper arrangement of drives and exclusive design of bases to reduce the striking

force the issue of control is the main problem of the robot used for walking.

Japan's Tokyo Institute of Technology developed KUMO-I - the first quadruped in 1976, in the subsequent years the same institute also produced TITAN series quadruped robots based on this study considered in an environment of flat surface, the robot walks steadily and hence mechanical translational system can be used to replace the servo motors at the leg joints [2,3,4,9]. Due to this alteration, the difficulties in

control, high cost and heaviness of the system are overcome and make it most suitable for commonplace applications [7,8]. To pursue this goal, the earlier research outcomes and theories are utilised to improve the system design and a modified quadruped robot mechanism which can be used for steady walking on a levelled surface is developed with a cam drive [5,6]

II. METHODOLOGY

This prime example is the real time working model that uses raspberry pi cam, with high resolution which is used to capture images and in addition to that capable of video streaming. Servo Motors are used for limb movements. Arduino UNO is the Arduino board I used in this. It is the master of the robot. The legs are assimilated with SERVO MOTORS which is used for the leg movements. They provide 0 to 180degree rotation. The code is provided for this bot to function. It is written in Arduino IDE. Each leg has 2 servos, so 8 servos are connected in total. The need for the driver PCA9685 is to connect more number of servos and these servos are powered from the supply connected to the driver. The operating voltage of each servo is 5v. Driver acts as the control for all the servos.

III. SERVO MOTORS

A servomotor gives linear and rotary motion and it can be controlled for any required linear or angular displacement. Its speed can also be controlled easily. These movement and speed can be controlled by providing feedback mechanism. A specific controller for the particular task along with position sensor is used to achieve better result of an automaton. Closed loop servo mechanism that employs position feedback is used to get a controlled motion and precise final position. The input to its control is a signal representing position commanded for the output shaft. Servomotors replace the stepper motor by its high performance. The placement of servos is decided based on the angle diagram. The minimum pulse has 0 degree in the servo motor, when it comes to 90 degree it is the neutral position, then maximum is 180 degree.

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Depending on the requirement the coding are done on the basis of requirement of angles of deflection by the servomotor.

IV. PCA9685 SERVO DRIVER

Servo driver deals with the PWM pulses. Pulse Width Modulation technique reduces the average power delivered by a sinusoidal signal and it effectively chops the signal into discrete parts. The switching frequency of PWM is to be high such that it will not get affected by loads. Whatever the switching frequency be, the resultant voltage received by the load is to be as smooth as possible. The pulse time for the servo varies with brand and model. Sometimes variation of pulse time will come in the same model and brand itself, since it is an analog control circuit. For precise control, calibration of minimum and maximum pulse width should match the positions.

V. STEPS TO INCLUDE SERVO LIBRARY

1. Click on the file in Arduino ide platform.
2. Click on the examples, add the Adafruit PWM servo driver library that is downloaded previously.
3. Click on the servo.

VI. INVERSE KINEMATICS

The scientific process of recreating the movements of an article in the world from external data, such as a action film or film of the outside world as visualized by a camera that makes its own arrangement for making the video is called as Inverse Kinematics. This is most suited technology for usage in robotics and in animatronics of moving films. Kinematic equations play an important role in Inverse Kinematics in the determination of important connected and relative parameters that are helpful in providing expected locations for each of the robot's end-effectors. Motion planning is defined as the confinement of a robotic design to standard specifications such that its end-effectors effectively achieve the desired tasks. It transmutes the planned motion into asymptotes for the robot joint actuator. Similar methods are used to formulate the positions of the minimal of an animated character that moves in a particular way in a flick or of a vehicular movement that carries the camera which is recording a scene of a film. Kinematic equations are used for modelling the displacement of a moving object which may be robot or an animation character. The detailed description of the moving object in terms of the joint parameters is obtained from these equations. Forward kinematics uses cooperative parameters to compute the conformation of the chain whereas the inverse kinematics reverses its calculation to determine the joint parameters that achieve a desired result. By using this method user can move the hand of a 3D human model to an expected position and orientation and have an algorithm to select the proper angles of various joints in the hand like wrist, elbow, shoulder etc. Accurate and precise execution of computer animatronics usually requires that the figure moves within reasonable and pre-defined limits.

VII. BLENDER

The software used for creation of 3D modelling, editing, composting etc. is Blender. The blender offers non-disruptive foundation 3D computer graphics. Even though it is simple, user-friendly and easy to use it contains the characteristic features of high end graphical software. Official releases of Blender for various operating systems as well as a port for connecting other electronic components are available in both 32 bit and 64 bit versions. Amalgamation with a number of external render engines through plugins. Modifiers to apply non-destructive effects. In this paper, the leg design is created in the Blender software.

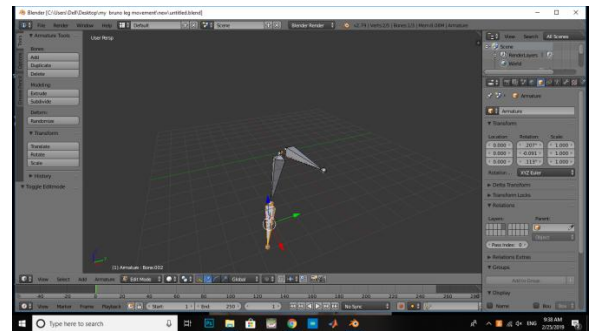


Figure1. Blender leg design

VI. FLOWCHART FOR BOT LOCOMOTION

Initially the servo angles are fixed for the limbs. This depends on the selection of angle and accordingly the code is made. The PWM frequency will be set for the bot to get the pulses as input. The set frequency is 60Hz. The servo counters are commenced. When the counter value is less than or equal to 8 then it will start to operate accordingly. When the condition is not satisfied, then the operation will not happen.

VII. RASPBERRY PI 3

The Raspberry pi is an ATM card sized independent processor board that can be used for multi tasks that a computer does. The raspberry pi is available in the market as model A and model B. The main difference between model A and model B is the availability of USB port. The major advantage of these boards is that they consume less power.

- **GPIO Pins:**
The general purpose I/O pins are used in the raspberry pi to inter-relate with the other electronic boards. These pins are capable of carrying out contribution and production commands based on programming raspberry pi.
- **Xbee Socket:**
The xbee socket is used in raspberry pi board for wireless communiqué purpose
- **Power Source Connector.**
The external power source is enabled by using a power source connector.

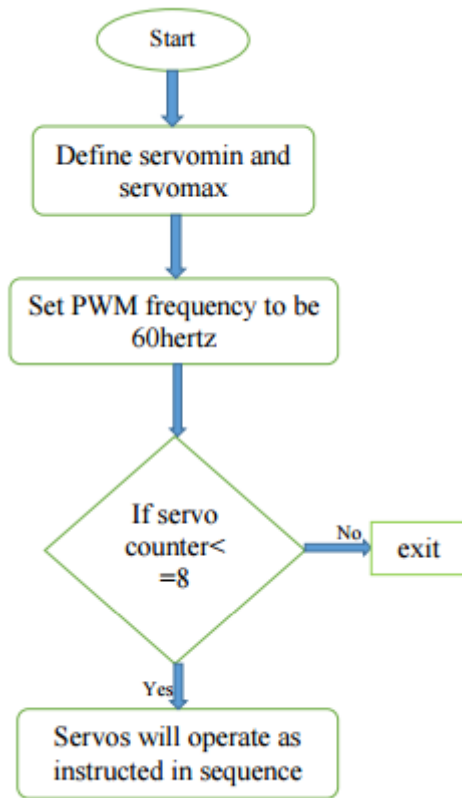


Figure 2. Flowchart for bot locomotion

VIII. RASPBERRY PI FISHEYE LENS CAM

- Wide angle 160 degree Fisheye lens camera, adjustable focal length.
- Night vision option, not including fill light.

IX. RESULT AND CONCLUSION

Hereby the final results are obtained in the graph. The hardware and software implementations are also shown in the figures 4, 5, and 6.

SOME IDEAS TO INCREASE THE SPEED

1. Instead of micro servos, standard servos can be implemented in big robots.
2. If delay is decreased, speed seems to be decreased and bot moves faster.
3. Another way of increasing the speed is to decrease the torque.

X. PROJECT OVERALL VIEW

When the Arduino board is powered with the supply, the actuators (i.e) the servo motors will receive power and start to rotate according to the code provided which lets the legs move either forward, backward, turns according to it. Simultaneously the live tracking is done by raspberry pi cam. It is provided with fish eye lens pi cam to get wider field of view. This is the new feature that I added in this project.

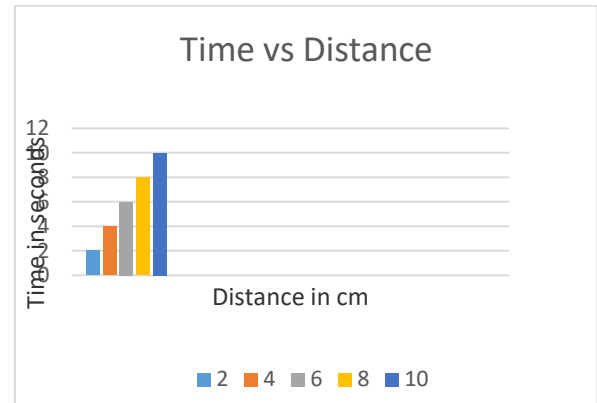


Figure 3. Time Vs Distance

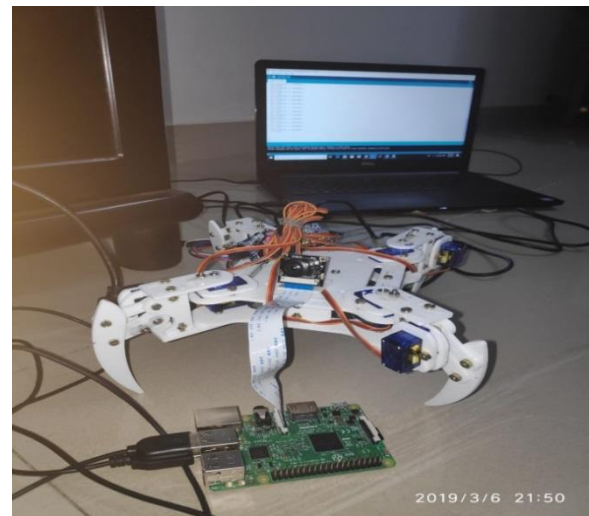


Figure 4. Hardware Implementation of the bot

XI. SOFTWARE IMPLEMENTATION

As per the requirement fish eye lens camera is connected to the raspberry pi board. This is going to capture images in the way it travels. The code is executed simultaneously for the movement of the bot.



Figure 5. Setup of the quadruped with camera

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Figure 6. View from Pi cam



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