© 2020 | International Journal of Scientific Research in Science and Technology
IJSRST | Volume 7 | Issue 2 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
DOI : https://doi.org/10.32628/IJSRST

AI Based Biped Robot

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ABSTRACT

In this paper, we focus on bipedal robot development and control for different surface conditions using an AI based approach. The core components of our existing robot are pressure sensor, servomotor and software-driven microcontroller. We performed robot system simulation for various ground surface conditions to control the robot with respect to pressure-sensing data that incorporates the two-way interactions between robot and ground. In our machine, we're imposing the robot which may be managed by means of ai. The movement of two-legged gadget is called as taking walks. Strolling can be statically or dynamically solid. Going for walks is usually dynamically solid. Airborne time for ASIMO is 0.08 sec. Keep foot flat at the floor (fully actuated). Estimate hazard of foot roll by means of measuring ground reaction forces. Cautiously design desired trajectories thru optimization. Keep knees bent (avoid singularity). The adaptive trajectory monitoring manages (high remarks profits). The maximum critical undertaking inside the development of biped robot is robotic mechanical structure. Stiffness and compliance consist with biped determine with flexibility of shape. The primary goal is to design a biped shape that may effortlessly control and capable of dealing with entire situation like humans. A normal man can weigh up to ten kg of load without difficulty and panting with accuracy. Even as designing we ought to remember such a lot of parameters inside the proposed machine, we're interfacing the flexi force sensor with Arduino mega. And measuring the foot stress of robotic after that send that fee to raspberry pi primarily based on ai robot will controlled mechanically. When people think of artificial intelligence (ai), the major image that pops up in their heads is that of a robot gliding around and giving mechanical replies.
Keywords : SVM, ANN, Supervised Learning, Arduino Mega, Flexi force sensor, Servo motors, Raspberry Pi.

I. INTRODUCTION

The A bipedal robot is a robotic structure with its body form constructed to resemble the human frame. The layout can be for purposeful purposes, inclusive of interacting with human gear and environments, for experimental purposes, which includes the observe of al locomotion, or for different purposes. Androids are robots constructed to aesthetically resemble people. Initially, the fundamental cause of an AI-based totally biped robotic is for studies. They had been being used for research to create better prosthetics for humans. Now Bipedal robot are being created for several purposes that aren't restrained to analyse modern-day-day robots are evolved to carry out the exceptional human mission and occupy special guidelines within the employment zone. Bipedal robots are able to move in areas which might be generally inaccessible to wheeled robots, including areas suffering from barriers that make wheeled locomotion not possible.

Initially, the major aim of AI for humanoids was for research purposes. They were being used for research on how to create better prosthetics for humans. Now, humanoids are being created for several purposes that are not limited to research. Modern-day humanoids are developed to carry out different human tasks and occupy different roles in the employment sector.

Problem Statement

Design and implement biped robot using AI which can walk on different surface Implement an Artificial Neural Network for supervised learning.

II. LITERATURE SURVEY

BACKGROUND STUDY

It is technically more difficult to implement algorithms for reliable locomotion in such robots than in e.g. wheeled robots. Bipedal robots are able to move in areas that are normally inaccessible to wheeled robots, such as areas littered with obstacles that make wheeled locomotion impossible. It is also easier for a biped robot to function in areas designed for people (e.g. houses, factories).

S. Bhattacharya, T. K Maiti, S. Duatta, A. Luo, M. Miura-Mattuausch and H. J. Mattuaush, 2018 IEEE. "System Simulation for Robot Control Based on AI Approach"

DESCRIPTION

The focus on real robot development and control for different surface conditions using an AI-based approach. Robot system simulation performed for various ground surface conditions to control the robot with respect to pressure-sensing data that incorporates the two-way interactions between robot and ground. Artificial neural network (ANN) approach is used for pressure-sensor data analysis. The analysis result shows that above 25 hidden neurons and an increasing number of training cycles will deliver better performance in terms of mean square error (mse), learning time and improved nearest surface-pattern recognition.

Jaroslaw Bilski, Jacek Smolag and Jacek M. Zurada, 2015. "Parallel Approach to the Levenberg-Marquardt Learning Algorithm for Feedforward Neural Network"

DESCRIPTION

A parallel architecture of the Levenberg-Marquardt algorithm for training a feedforward neural network is presented. The proposed solution is based on completely new parallel structures to effectively reduce high computational load of this algorithm. The LM algorithm is one of the most effective learning methods but requires particularly complex calculations. Unfortunately, for very large networks the computational load of the LM algorithm makes it impractical. A suitable solution to this problem is the use of high performance dedicated parallel structures.

Ryan W. Sinnet, Matthew J. Powell, Rajiv P. Shah, Aaron D. Ames, Sept. 2011. "A Human-Inspired Hybrid Control Approach to Bipedal Robotic Walking:"

DESCRIPTION

A human-inspired method for achieving bipedal robotic walking is proposed, in which a hybrid model of a human is used in conjunction with experimental walking data to obtain a multidomain hybrid system. Walking data were collected for test subjects; these data are analysed in terms of the kinematics of walking. In bipedal walking, certain points on the body are constrained for various intervals throughout the gait; this phenomenon is used to formally break gait into walking phases.

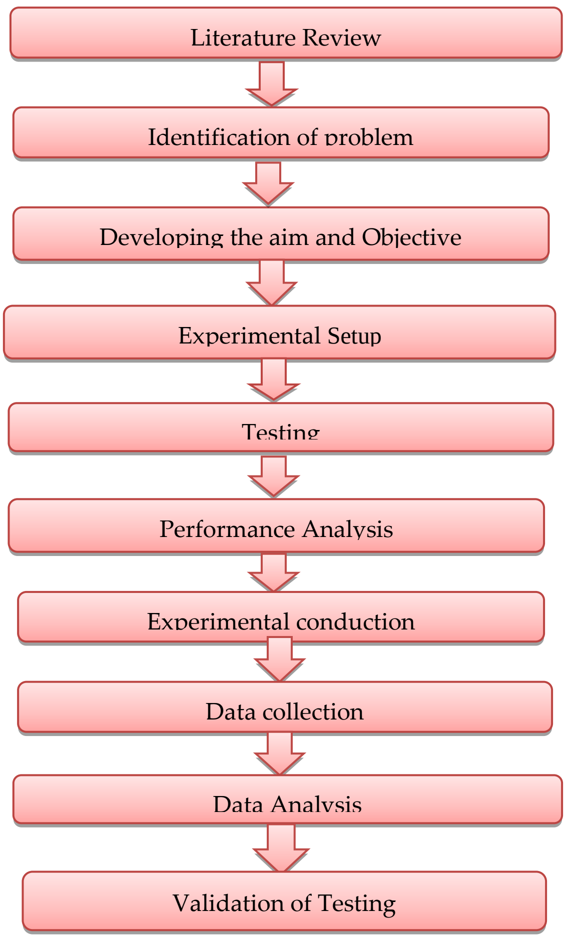
Hai-Wu-Lee, Jin-long Yang, Shao-Quan Zhang, and Qi Chen, 2018 IEEE. "Research on the Stability of Biped Robot Walking on the Different Road Surfaces:"

DESCRIPTION

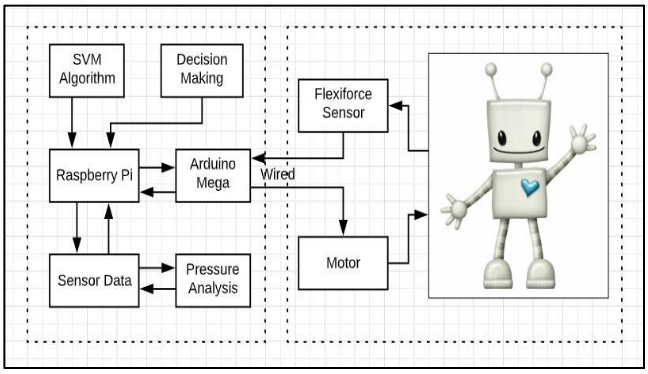
Balance research is the key to achieving stable walking of biped robots. Firstly, based on the zero-moment point and kinematics theory, the pose of the biped robot is analysed and calculated in DH coordinate system. Through the communication between the Arduino UNO and the servo motor driver board, the control signals of the servo motor are transmitted so that the robot can perform such actions as lifting the leg, stepping forward, and moving the left and right hip joints.

III. SYSTEM OVERVIEW

The progress in the research work can be observed as,



Block Diagram



Working

The biped robot system employs two legs which are connected with pressure sensors under the feet. In this system, robot feet collect pressure from the ground when the robot puts his feet on the ground, that is collected by the Flexi force sensor. The robot-sensor-data analysis using an AI algorithm is proposed. Machine learning is a part of AI algorithms useful for sensor data analysis. We have proposed support vector machine and artificial neural network approach for pressure-sensor-data analysis. If pressure value is above than set value then it goes to raspberry pi & controller. This collected data is input for training module. Then, microcontroller performs an operation, pressure data analysis is done by the database values then by decision making is done and the robot is stable or not is done from this analysis. Increasing number of training cycles will deliver better performance in terms of mean square error (MSE), learning time and improved nearest surface-pattern recognition. The analysis results are useful for next generation ai-chip development for real-time robot control and movement.

IV. TOOLS AND PLATFORM

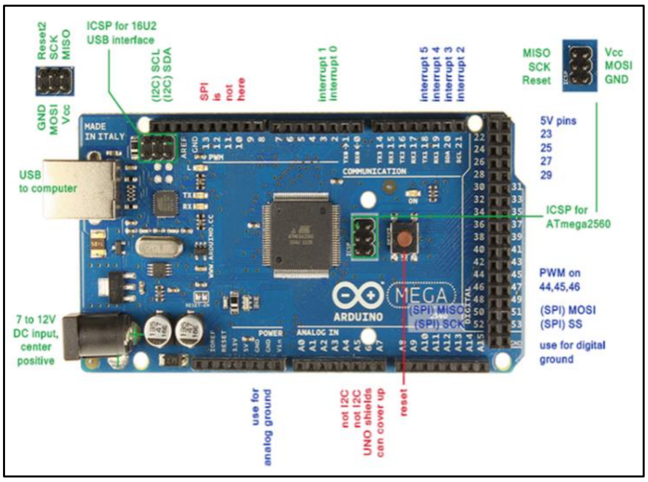
Hardware requirement

- Arduino mega
- Raspberry pi
- flexi force sensor

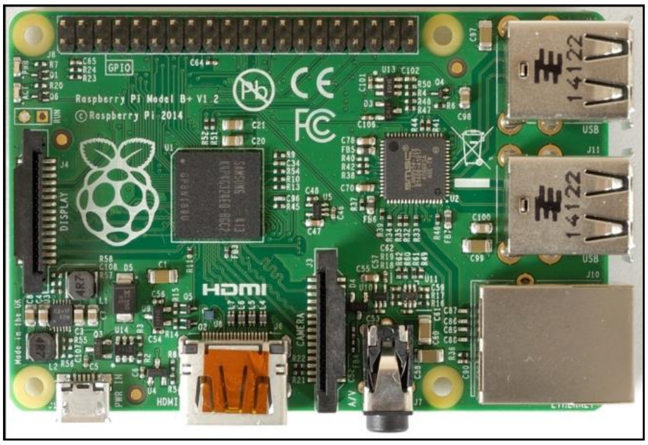
• servo motor
• SD Card
• Power supply
• Pi camera

Arduino mega

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analogue inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

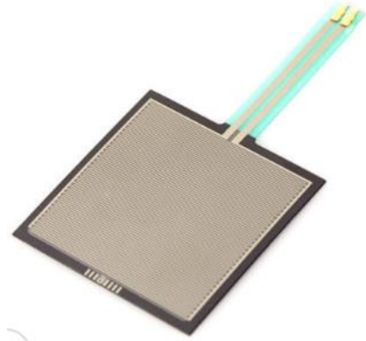


Raspberry Pi



Raspberry Pi Model, 512 Mb with a nice black plastic case: The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It has the ability to interact with the outside world, and has been used in real time applications. This board is the central module of the whole embedded image capturing and processing system as given in figure. Its main parts include: main processing chip, memory, power supply HDMI Out, Ethernet port, USB ports and abundant global interfaces.

Flexi Force Sensor



The FlexiForce sensor acts as a force sensing resistor in an electrical circuit.

When the force sensor is unloaded, its resistance is very high. When a force is applied to the sensor, there is a proportional decrease in resistance.
The unique construction of FlexiForce sensors brings the following advantages to your product design:

- ✓ thinness [0.008 in. (.203 mm)]
- ✓ better linearity than other force sensitive resistors, which simplifies calibration
- ✓ measurement of higher loads than other force sensitive resistors
- ✓ stable output with respect to load area

Software requirement

- ✓ Python (Programming)
- ✓ Arduino IDE (Programming)
- ✓ Proteus (Simulation)

1) PYTHON

Python is a widely used high-level, general-purpose, interpreted, dynamic programming language. Its design philosophy emphasizes code readability, and its syntax allows programmers to express concepts in fewer lines of code than possible in languages such as C++ or Java. The language provides constructs intended to enable writing clear programs on both a small and large scale.

Python supports multiple programming paradigms, including object-oriented, imperative and functional programming or procedural styles.

2) ARDUINO IDE

- ✓ Plug in your board and wait for Windows to begin its driver installation process.
- ✓ After a few moments, the process will fail, despite its best efforts.
- ✓ Click on the Start Menu, and open up the Control Panel.
- ✓ While in the Control Panel, navigate to System and Security. Next, click on System.
- ✓ Once the System window is up, open the Device Manager.
- ✓ Look under Ports (COM & LPT). You should see an open port named "Arduino UNO (COMxx)". If there is no COM & LPT section, look under 'Other Devices' for 'Unknown Device'.

3) PROTEUS

The micro-controller simulation in Proteus works by applying either a hex file or a debug file to the microcontroller part on the schematic. It is then co-simulated along with any analogue and digital electronics connected to it. This enables its use in a broad spectrum of project prototyping in areas such as motor control, temperature control and user interface design. It also finds use in the general hobbyist community and, since no hardware is required, is convenient to use as a training or teaching tool.

V. DESIGN AND IMPLEMENTATION

S= {I, FUN, OP, S}
Input:
I = {FFS, M, AM, RPI, R}.
FFS is Flexi Force Sensor.
M is Motor.
AM is Arduino Mega.
RPI is Raspberry.
R is Robot.

Functions
FUN= {DB, CD, C}
DB is the set of sense value in database.
CD is the capture data for decision making.
C is configured data.

Output:
OP= {S, U}
S = Stable robot movement.
U = Unstable robot movement

Failure:
F= {Fl, F2}
Fl = Decision making not done properly by Raspberry Pi.
F2 = Arduino mega can't control operation.

Success:
S= {S1, S2, S3}
S1 = Moving robot leg like move left leg & right leg one by one.
S2 = Raspberry Pi makes decisions properly.
S3 = Arduino mega Control operation.

SVM ALGORITHM

For a dataset consisting of features set and labels set, an SVM classifier builds a model to predict classes for new examples. It assigns new example/data points to one of the classes. If there are only 2 classes then it can be called as a Binary SVM Classifier.

There are 2 kinds of SVM classifiers:
1. Linear SVM Classifier
2. Non-Linear SVM Classifier

Linear Support Vector Machine Classifier

In Linear Classifier, A data point considered as a p-dimensional vector (list of p-numbers) and we separate points using (p-1) dimensional hyperplane. There can be many hyperplanes separating data in a linear order, but the best hyperplane is considered to be the one that maximizes the margin i.e., the distance between the hyperplane and closest data point of either class.
The Maximum-margin hyperplane is determined by the data points that lie nearest to it. Since we have to maximize the distance between the hyperplane and the data points. These data points which influence our hyperplane are known as support vectors.

Non-Linear Support Vector Machine Classifier

Vapnik proposed Non-Linear Classifiers in 1992. It often happens that our data points are not linearly separable in a p-dimensional (finite) space. To solve this, it was proposed to map p-dimensional space into a much higher-dimensional space. We can draw customized/non-linear hyperplanes using the Kernel trick. Every kernel holds a non-linear kernel function.

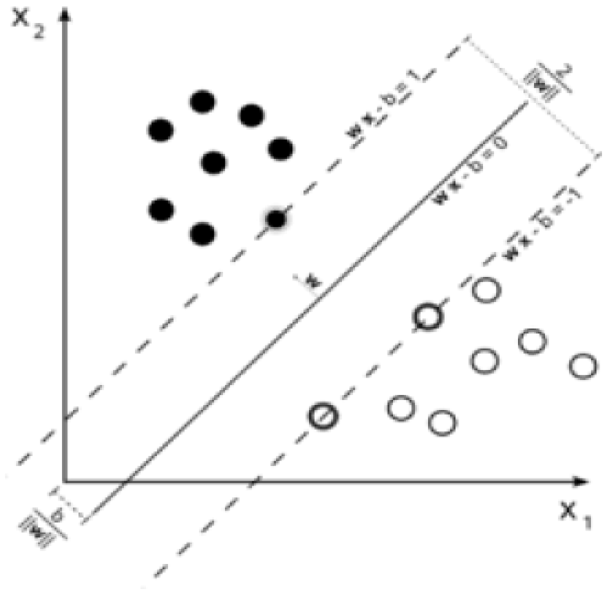
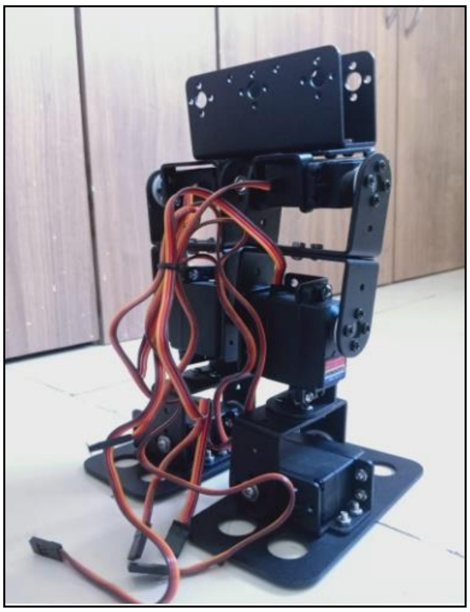


Figure : Selecting the SVM Hyperplanes

Linearly Separable:

For the data which can be separated linearly, we select two parallel hyperplanes that separate the two classes of data, so that distance between both the lines is maximum. The region b/w these two hyperplanes is known as “margin” & maximum margin hyperplane is the one that lies in the middle of them.

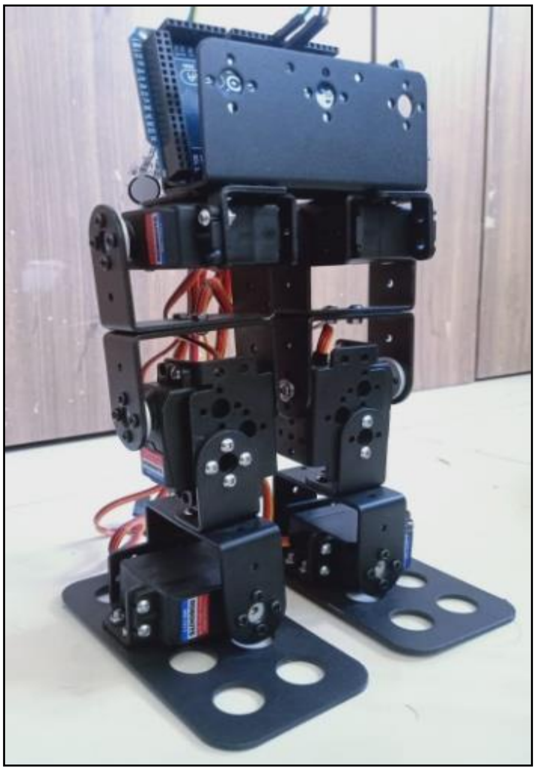
VI. RESULTS

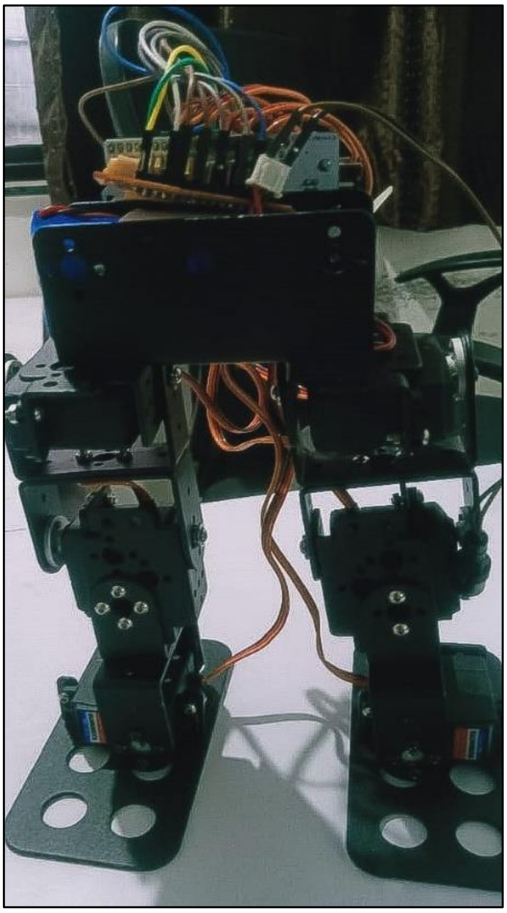


We have implemented a project; in this we install all the components in the board which are perfectly connected to the controller we are used. A microcontroller which is used to control all the operations

A circuit shows the motor configuration connection, we have to Control the robot as per the pressure values using flexi force sensor in uneven surface.

A flexi force sensor is used to measure the foot pressure. All the connections are working properly and a fully demonstration of project will be done.





VII. CONCLUSION AND FUTURE SCOPE

In this paper, the surface condition detection is considered by a biped robot for its smooth control using an AI approach. A supervised learning mechanism is considered for real time analysis of pressure sensor data from the feet of walking robot. The analyzed data are useful for future decision making to improve robot control. The primary cause of this undertaking is to make the robotic solid and generate a solid strolling pattern. A on foot manage algorithm human-like sole this is floor shape adaptive and ground reaction pressure absorptive. Inside the case of a human soul, the thick and soft pores and skin absorbs landing effect and adapts to uneven floor. For a biped robot that considers an easy ground is developed and examined. A hit forward, backward strolling at the flat surface was realized, and the effectiveness of the proposed walking set of rules was thereby verified. Thru numerous experiments, its miles established the overall performance of the strong biped walking pattern era algorithm. The effectiveness of the walking manipulate approach proposed and the strolling systems are experimentally examined on a biped robotic.

VIII. REFERENCES

[1]. S. Bhattacharya, T. K Maiti, S. Duatta, A. Luo, M. Miura-Mattuausch and H. J. Mattuaush, "System Simulation for Robot Control Based on AI Approach",2018 IEEE

[2]. Ryan W. Sinnet, Matthew J. Powell, Rajiv P. Shah, Aaron D. Ames, "A Human-Inspired Hybrid Control Approach to Bipedal Robotic Walking", The International Federation of Automatic Control Milano, Sept. 2011

[3]. Hai-Wu-Lee, Jin-long Yang, Shao-Quan Zhang and Qi Chen, "Research on the Stability of Biped Robot Walking on the Different Road Surfaces", International Conference, IEEE 2018

[4]. Hao Yu, Bogdan M. Wilamowski," Levenberg-Marquardt Training", Conference Paper,2010

[5]. Philipp Allgeuer and Sven Behnke, "Bipedal Walking with Corrective Actions in the Tilt Phase Space", 2018 IEEE-RAS 18th International Conference on Humanoid Robots (Humanoids) Beijing, China, November 6-9, 2018