Proposal for

SUMMER UNDERGRADUATE RESEARCH AWARD
(SURA) – 2016

Design and Implementation of Obstacle detection algorithm for Semi-Autonomous Robot using Neural Network

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INTRODUCTION

Neural networks are recommended for intelligent control as a part of well-known structures with adaptive critic. Recently, the neural network-based control of mobile robots has been the subject of intense research. It is usual to work with kinematic models of mobile robot to obtain stable motion control laws for trajectory following or goal reaching.

The neural network in our robot will be trained for recognizing obstacle that the bot can overcome and returning control to the master if it comes across one it can't. Thus this will not be a completely autonomous, but a semi-autonomous robot which will have huge applications in places where bot has to navigate through an unknown environment. It can be used for moving on predefined path or for mapping of foreign environment etc.

The Neural Network of the bot will be able to recognize known obstacles, which are "taught" during the training period, and overcome them. When an object is encountered which the robot thinks it cannot cross it will ping the user about the novel obstacle. The user will then take over the control of the robot and navigate as he desires. If it knows the obstacle it will modify its path accordingly. We will be implementing neural network on a mobile robot with non-holonomic constraints.

The project, later on could be extended such that the bot will learn how to overcome an obstacle from the master during the manual control and use the information for next obstacle while following a predefined path.

OBJECTIVE

- Developing a Neural Network capable of identifying obstacles it can overcome.
- Implement the Neural Network on a mobile robot.
- Develop electrical circuit for detection of surroundings with appropriate sensor selection.
- Develop an operational, semiautonomous mobile robot.

LEVEL OF IMPLEMENTATION

At first we will work in a controlled environment with simple shaped objects as obstacle and teach the bot to recognize them and select predefined path alterations for different obstacles.
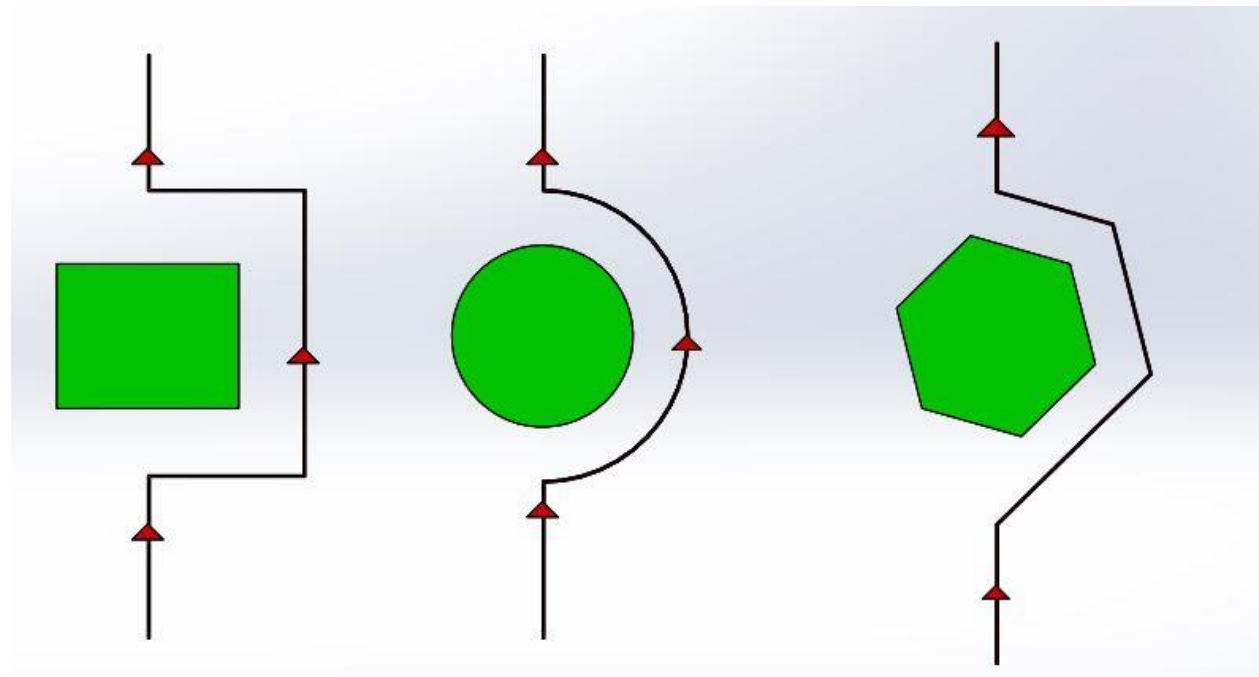
APPROACH

Mechanical

The initial part of the project will be designing mechanical body of the robot with the help of CAD modelling software. Next part includes manufacturing and fabrication of individual mechanisms and chassis. If possible we will be using an existing bot.

Electrical

Next section includes selection and calibration of various sensors like Camera, proximity sensor (obstacle detection), motor drivers e.g. Sabertooth (for motor control), encoders (path following) etc.

Neural Network

The multilayered network will take inputs from array of sensors or camera which in turn will be fully connected to the output layer. The output layer determines whether it knows the obstacle or not. If it knows the obstacle it will make desired changes in its path that has already been taught.

Network Training:

The network is trained to produce the correct decision using the backpropagation learning algorithm. In backpropagation, the network is presented with an input and activation is propagated forward through the network to determine the network's response. The network's response is then compared with the known correct response. If the network's actual response does not match the correct response, the weights between connections in the network are modified slightly to produce a response more closely matching the correct response.

Development of a neural network for our specific purpose will be our next step. This will include studying existing models of neural network for related purpose. Modifying the network to transform it from autonomous to semiautonomous bot.

Next we will train the neural network for various environments. This will include subjecting the bot to obstacle of various shapes and size. Finding out if it a known obstacle or not and selection of desired path alteration for crossing the obstacle and passing the control to the user if it is an unknown shape.

Finally we will test it on an alien environment with a predefined path and with known and unknown obstacle in its way.

APPLICATION

These types of robots are very essential for exploring new places, like where a bot has to navigate in a dense forest or in a deep cave ie places that are not known. It can be used for mapping of unknown environment. Bots send to other planets can also use such control where a certain level of autonomous control is essential but we also want to take all the major decisions.

DURATION

Week	1	2	3	4	5	6	7	8
	Designing and manufacturing of a robust mechanical structure of the robot with electrical circuit	Implementation of neural networking for our specific purpose				Training period for the robot	Final run in an alien environment	

BUDGET

S. No.	component	Estimated cost (INR)
1.	Beaglebone (microprocessor)	4000
2.	Camera	3000
3.	Proximity sensors	800
4.	Motors	4000
5.	Manufacturing	4000
	Total	15800

FACILITIES REQUIRED

Proximity sensor from vibration lab or design lab
Access to labs of mechanical, electrical and electronics department
Access to CAD modeling (solidworks)
We will be requiring 3D printing and circuit designing facilities like PCB printing, soldering etc.

REFERENCES

[1] http://robotics.hobbizine.com/arduinoann.html

[2]http://research.ibm.com/people/j/jhc/pubs/jhc-mred.pdf

[3]   http://www.intechopen.com/books/new-trends-in-technologies/design-of-neural-network-mobile-robot-motion-controller