Microcontroller Based Neural Network Controlled Low Cost Autonomous Vehicle

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ABSTRACT: Neural networks have become a growing area of research over the last few decades and have affected many branches of industry. In this project, design of a low cost autonomous vehicle based on neural network for navigation in unknown environments is presented. The conceptual high-level design of a low cost neural network based autonomous vehicle is presented. The vehicle is equipped with IR Transmitter and IR Receiver which is used to find the obstacle in the path of the Vehicle, a GSM modem for changing destination place on run time, Motor Driver is used to drive the motors, all interfaced to a low cost ATmega128 microcontroller. When going to the destination if there is any obstacle it will be observed by using IR Transmitter and Receiver and make the vehicle to rotate and move to destination position. Once the vehicle reaches the destination the Buzzer will switches on.

The microcontroller processes the information acquired from the sensors and generates robot motion commands accordingly through neural network. The neural network running inside the microcontroller is a multilayer feed-forward network with back-propagation training algorithm. The network is trained offline with tangent-sigmoid as activation function for neurons and is implemented in real time with piecewise linear approximation of tangent-sigmoid function. Results have shown that upto twenty neurons can be implemented in hidden layer with this technique. The vehicle is tested with varying destination places in outdoor environments containing stationary as well as moving obstacles and is found to reach the set targets successfully.

Keywords: **Atmega128, gsm, gps , dc motors, target co-ordinates through gsm, gps tracking, hurdle avoidance through ir sensors,track path,reach destination**

I. INTRODUCTION

Neural network is a mathematical model inspired by biological neural networks. It consists of an interconnected group of artificial neurons and it processes information using a connectionist approach to computation. It is an adaptive system that changes its structure during a learning phase. Neural networks are used to model complex relationships between inputs and outputs or to find data pattern.

Neural Network Controlled Low Cost Autonomous Vehicle aims at designing and executing the obstacle detection and avoidance vehicle. A vehicle obstacle detection system includes a robot housing which navigates with respect to the surface and a sensor subsystem having a defined relationship with respect to the housing and aimed at the surface for detecting the surface.

The transmitter sends the ultrasonic waves, and if the receiver senses any of the transmitted signal it indicates the presence of an obstacle. If the receiver doesn't sense any signal it indicates the absence of obstacle.

The need of implementing this project can be explained as follows:

Automobiles have been the ardent Revolutionized Product of the Scientific Developments of the Mankind. They have increasingly becoming the Must have aspects of Human Lives. From providing one of the faster modes of Transportation to creating whole new concept of harnessing Technology for advanced features.

1. This project presents an evolutionary method for creating an artificial neural network based autonomous land vehicle controller. The evolved controllers perform better in unseen situations than those trained with an error back propagation learning algorithm designed for this task.
2. In this project, an overview of the previous connectionist based approaches to this task is given, and the evolutionary algorithms used in this study are described in detail. Methods for reducing the high computational costs of training artificial neural networks with evolutionary algorithms are explored.
3. Error metrics specific to the task of autonomous vehicle control are introduced; the evolutionary algorithms guided by these error metrics reveal improved performance over those guided by the standard sum-squared error metric.
4. Finally, techniques for integrating evolutionary search and error back propagation are presented.

II. LITERATURE SURVEY

The term **neural network** was traditionally used to refer to a network or circuit of biological neurons. The modern usage of the term often refers to artificial neural networks, which are composed of artificial neurons or nodes. Thus the term has two distinct usages:

1. Biological neural networks are made up of real biological neurons that are connected or functionally related in a nervous system. In the field of neuroscience, they are often identified as

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groups of neurons that perform a specific physiological function in laboratory analysis.

2. Artificial neural networks are composed of interconnecting artificial neurons (programming constructs that mimic the properties of biological neurons). Artificial neural networks may either be used to gain an understanding of biological neural networks, or for solving artificial intelligence problems without necessarily creating a model of a real biological system. The real, biological nervous system is highly complex: artificial neural network algorithms attempt to abstract this complexity and focus on what may hypothetically matter most from an information processing point of view. Good performance (e.g. as measured by good predictive ability, low generalization error), or performance mimicking animal or human error patterns, can then be used as one source of evidence towards supporting the hypothesis that the abstraction really captured something important from the point of view of information processing in the brain. Another incentive for these abstractions is to reduce the amount of computation required to simulate artificial neural networks, so as to allow one to experiment with larger networks and train them on larger data sets.

A biological neural network is composed of a group or groups of chemically connected or functionally associated neurons. A single neuron may be connected to many other neurons and the total number of neurons and connections in a network may be extensive. Connections, called synapses, are usually formed from axons to dendrites, though microcircuits and other connections are possible. Apart from the electrical signalling, there are other forms of signalling that arise from neurotransmitter diffusion.

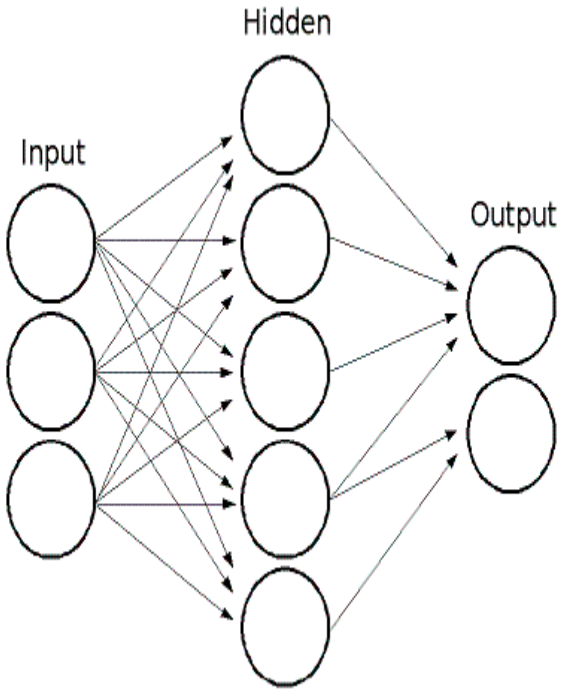
Artificial intelligence and cognitive modelling try to simulate some properties of biological neural networks. While similar in their techniques, the former has the aim of solving particular tasks, while the latter aims to build mathematical models of biological neural systems.

In the artificial intelligence field, artificial neural networks have been applied successfully to speech recognition, image analysis and adaptive control, in order to construct software agents (in computer and video games) or autonomous robots. Most of the currently employed artificial neural networks for artificial intelligence are based on statistical estimations, classification optimization and control theory.

The cognitive modelling field involves the physical or mathematical modelling of the behaviour of neural systems; ranging from the individual neural level (e.g. modelling the spike response curves of neurons to a stimulus), through the neural cluster level (e.g. modelling the release and effects of dopamine in the basal ganglia) to the complete organism (e.g. behavioural modelling of the organism's response to stimuli). Artificial intelligence, cognitive modelling, and neural networks are information processing paradigms inspired by the way biological neural systems process data.

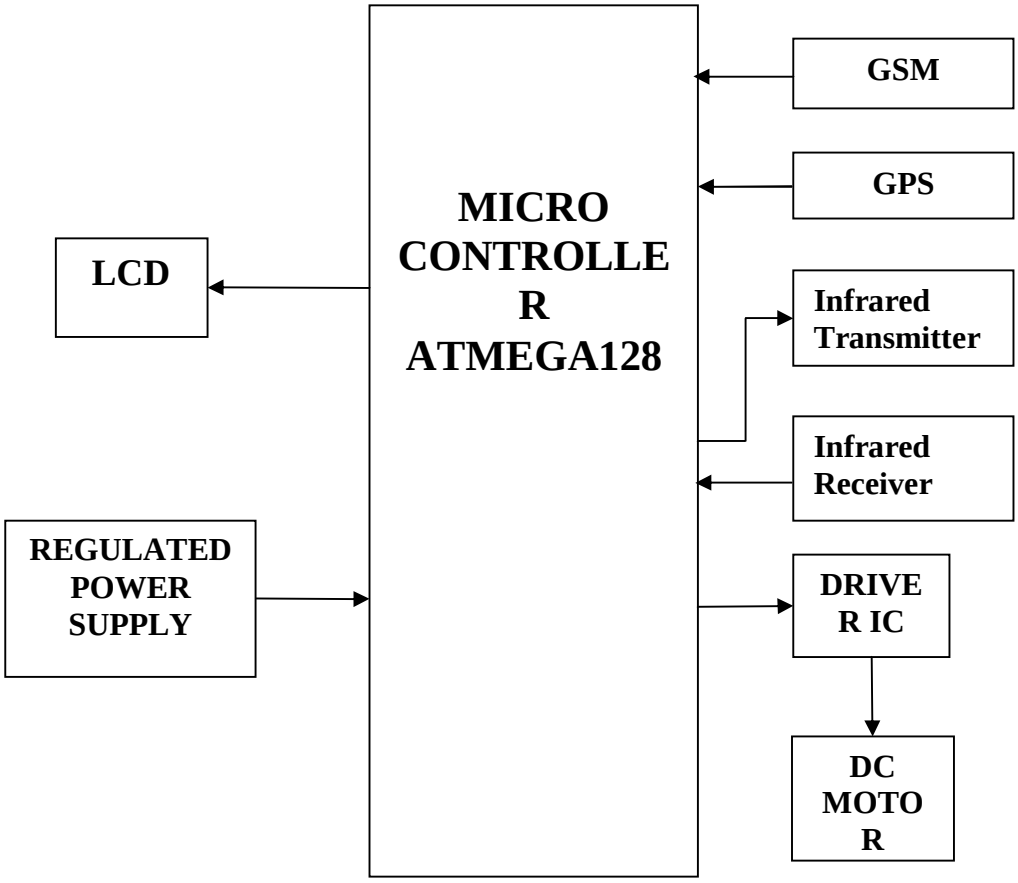
Many models are used; defined at different levels of abstraction, and modelling different aspects of neural systems. They range from models of the short-term behaviour of individual neurons, through models of the dynamics of neural circuitry arising from interactions between individual neurons, to models of behaviour arising from abstract neural modules that represent complete subsystems. These include models of the long-term and short-term plasticity of neural systems and its relation to learning and memory, from the individual neuron to the system level.

While initially research had been concerned mostly with the electrical characteristics of neurons, a particularly important part of the investigation in recent years has been the exploration of the role of neuron modulators such as dopamine, acetylcholine, and serotonin on behaviour and learning.



Biophysical models, such as BCM theory, have been important in understanding mechanisms for synaptic plasticity, and have had applications in both computer science and neuroscience. Research is ongoing in understanding the computational algorithms used in the brain, with some recent biological evidence for radial basis networks and neural back propagation as mechanisms for processing data.

III. BLOCK DIAGRAM



Block Diagram Explanation:

1. At the input side ATMEGA 128 has four inputs namely.
   - Regulated Power Supply.
   - GSM Module
   - Infrared Receiver Section.
2. The Microcontroller we are chosen here is ATMEGA128. This AVR ATmega128 controller consists of two RS232 ports which are able to communicate with GPS and GSM modem at a time. The operating voltage of AVR is 3.3V. Hence, in power circuit block the Regulated Power Supply is designed in such a way that we obtain a input voltage to AVR ATMEGA128 of 3.3V.
3. The Processing Section Comprises of Execution of given commands to AVR through the Input Section. The target location values (Longitude & Latitude) are sent as message to GSM module which is connected to the Controller.
4. The controller will analyze the current position values of the vehicle and comp area it to destination position value and make the motors to rotate such that it reaches the Destination. When going to the destination if there is any obstacle it will be observed by using IR Transmitter and Receiver and make the vehicle to rotate and move to destination position. The Driver IC is used for providing the mobilization of the vehicle.
5. After the Processing of the input, once the vehicle reaches the destination the Buzzer will switches on.
6. For making the project User friendly, we have side by side interfaced with the LCD for displaying the output.

IV. ADVANTAGES AND APPLICATIONS

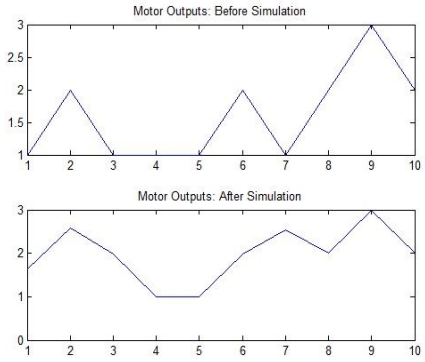
1. Feed forward neural networks have a fixed computation time
2. The complexity of the system is reduced by making it modular.
3. Low cost autonomous vehicle.

Applications:

1. Can be used in campus.
2. Can be used in wheel chairs as a navigation aid for disabled persons.
3. Can be used for transportation of light equipments.
4. Can be used in autonomously flying aircraft.
5. Can be used to detect credit card defaults.

V.RESULT AND CONCLUSIONS

A. **Result:** Thus the neural network follows the given input output pattern.



B. **Conclusion:**

Thus we have designed Microcontroller Based Low Cost Autonomous Vehicle Using Neural Network Technology. We will be implementing the same on a Robot which will be loaded with the software code and the necessary movements can be obtained using a controlling device.

VII. ACKNOWLEDGEMENT

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