Bio-Inspired Group Modeling and Analysis for Intruder Detection in Mobile Sensor/Robotic Networks

Mrs.S.Latha Bhuvaneswari
Asst. Professor SRM University, Chennai

***Abstract*- Although previous bio-inspired models have concentrated on invertebrates (such as ants), mammals such as primates with higher cognitive function are valuable for modeling the increasingly complex problems in engineering. Understanding primates social and communication systems, and applying what is learned from them to engineering domains is likely to inspire solutions to a number of problems. This paper presents a novel bio-inspired approach to determine group size by researching and simulating primate society. Group size does matter for both primate society and digital entities. It is difficult to determine how to group mobile sensors/robots that patrol in a large area when many factors are considered such as patrol efficiency, wireless interference, coverage, iter/intragroup communications, etc. This paper presents a simulation-based theoretical study on patrolling strategies for robot groups with the comparison of large and small groups through simulations and theoretical results.**

***Index Terms*- Bio-inspired communication, robot grouping,**

I. INTRODUCTION

Mobile robots equipped with sensors are able to cooperatively work together via wireless communication technologies in order to achieve and obtain surveillance teaming as well as task accomplishments in a large, complex field [1],[2]. The major challenges of communication in the large and complex field are considered that the number of mobile sensors is insufficient for a constantly available network used by intra/intergroup. While each group may be able to maintain communication within the group at all times, complete path for constant end-to-end data communication for any pairs of source and destination in different groups may not exist. There are always unmonitored locations due to the limite number of mobile sensors/robots that cannot monitor and cover the whole field. In order to solve such a problem, the mobile robots/sensors need to patrol the entire field in order to cover it completely. Unfortunately, we are uncertain as to how to group the robots/sensors to achieve a low cost. The size of the robot/sensor groups could be either large or small.

The members in the group communicate via facial expressions, body postures, and vocal communication [3], [4]. Communication within each group is complicated because of the large number of members in the group. Titi monkeys, however, live in small groups that only consist of the parents and their offspring [5], [6], and [7]. Each group of titi monkeys contains a total of 2–7 animals [6].

II. EXISTING SYSTEM

We consider intruders as robots which misbehave, i.e. do not follow the rules, because of either spontaneous failures or malicious reprogramming. Our goal is to detect intruders by observing the congruence of their behavior with the social rules as applied to the current state of the overall system. Moreover, the detection itself must be performed by individual robots, based only on local information.

III. DISADVANTAGE OF EXISTING SYSTEM

1) Do not follow the rules
2) Monitoring process only possible
3) Prevention process not possible

IV. PROPOSED SYSTEM

The proposed system of our project is to monitor the border of the nation by using robots. The image processing will be done by using the MATLAB. The information will be transmitted through the WSN transmitter. And the control will be to mode of operation are Automatic and Manual mode in robot section, Robot monitors the boundary compare with the information from the WSN receiver. If any intruder is found, then the robot will automatically emit the chloroform. Ultrasonic sensor used to find the obstacle. If obstacle is present automatically it will take another path. If human will detected around the robot then laser light will be turn on. If anyone attacks that robot then it will get self-destructed.

BLOCK DIAGRAM:

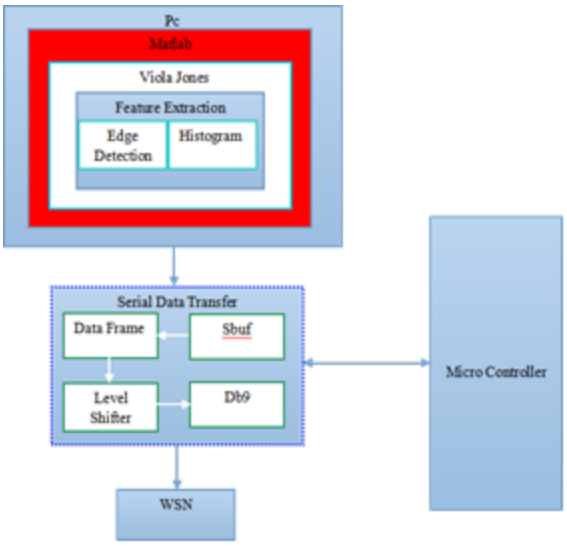

Figure 1: Matlab section

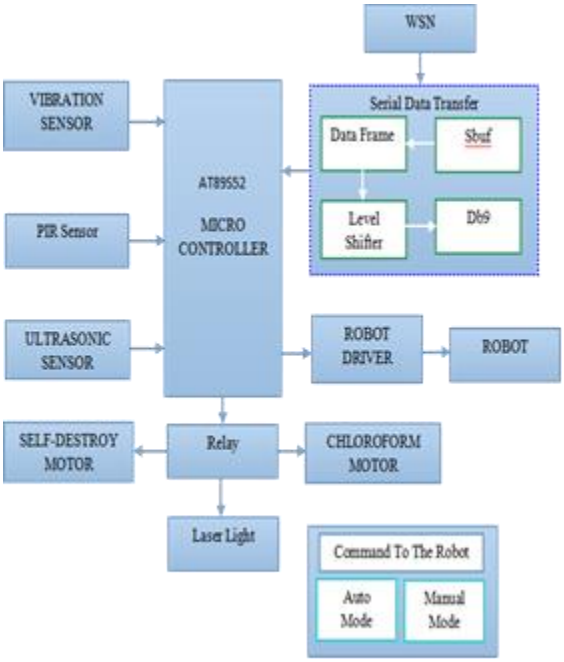

Figure 2: Robot section

Figure 3 At89s52 microcomtroller

Figure 3 shows the AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory [8], [9]. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the Indus-try-standard 80C51 instruction set and pin out.

Features:

1) Compatible with MCS®-51 Products.
2) 8K Bytes of In-System Programmable (ISP)
3) Flash Memory–Endurance: 1000 Write/Erase Cycles.
4) 4.0V to 5.5V Operating Range.
5) Fully Static Operation: 0 Hz to 33 MHz
6) Three-level Program Memory Lock.
7) 256 x 8-bit Internal RAM.
8) 32 Programmable I/O Lines.
9) Three 16-bit Timer/Counters.
10) Eight Interrupt Sources.
11) Full Duplex UART Serial Channel.
12) Low-power Idle and Power-down Modes.
13) Interrupt Recovery from Power-down Mode.
14) Watchdog Timer.
15) Dual Data Pointer.
16) Power-off Flag.
17) Fast Programming Time.
18) Flexible ISP Programming (Byte and Page Mode).
19) Green (BP/Halide-free) Packaging Option.

Description:

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the Indus-try-standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory pro-grammars. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible solution to many embedded control applications. The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry.

PIN CONFIGURATION

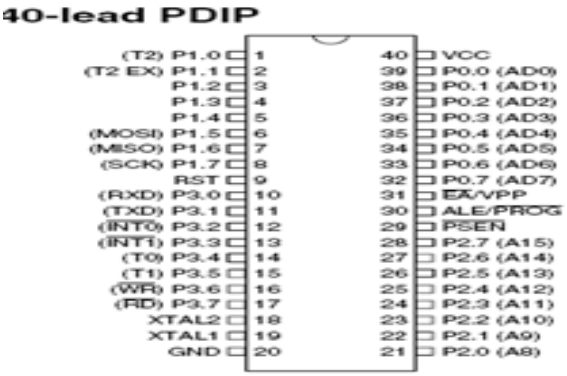

Figure 4 Pin configuration

Figure 5 Vibration sensor

Figure 5 shows piezoelectric sensors have proven to be versatile tools for the measurement of various processes. They are used for quality assurance, process control and for research and development in many different industries. Although the piezoelectric effect was discovered by Curie in 1880, it was only in the 1950s that the piezoelectric effect started to be used for industrial sensing applications. Since then, this measuring principle has been increasingly used and can be regarded as a mature technology with an outstanding inherent reliability. It has been successfully used in various applications, such as in medical, aerospace, nuclear instrumentation, and as a pressure sensor in the touch pads of mobile phones. In the automotive industry, piezoelectric elements are used to monitor combustion when developing internal combustion engines. The sensors are either directly mounted into additional holes into the cylinder head or the spark/glow plug is equipped with a built in miniature piezoelectric sensor The rise of piezoelectric technology is directly related to a set of inherent advantages. The high modulus of elasticity of many piezoelectric materials is comparable to that of many metals and goes up to 10e6 N/m². Even though piezoelectric sensors are electromechanical systems that react to compression, the sensing elements show almost zero deflection.

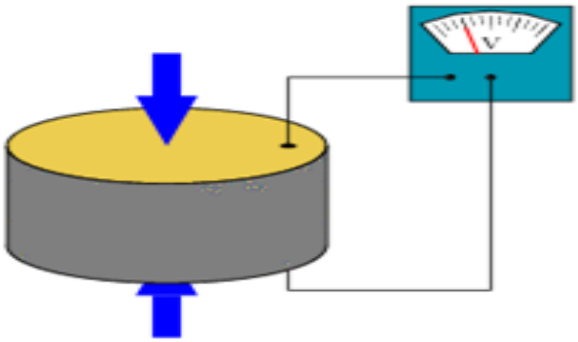

Figure 6

One disadvantage of piezoelectric sensors is that they cannot be used for truly static measurements. A static force will result in a fixed amount of charges on the piezoelectric material. While working with conventional readout electronics, imperfect insulating materials, and reduction in internal sensor resistance will result in a constant loss of electrons, and yield a decreasing signal.

UART:

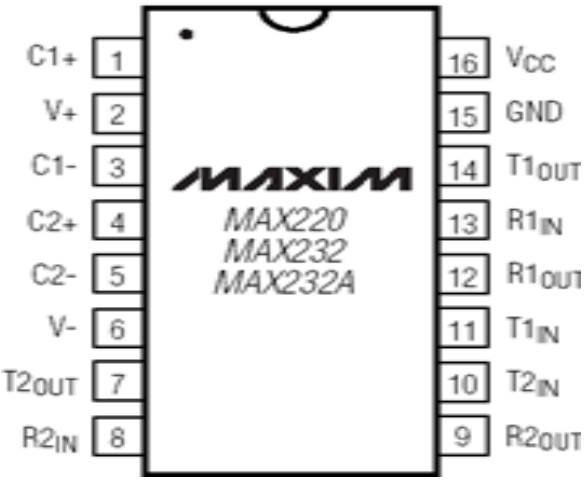

Figure 7 UART

Figure 7 shows a universal asynchronous receiver/transmitter is a type of "asynchronous receiver/transmitter", a piece of computer hardware that translates data between parallel and serial forms. [10]UARTs are commonly used in conjunction with other communication standards such as EIA RS-232.A UART is usually an individual (or part of an) integrated circuit used for serial communications over a computer or peripheral device serial port. UARTs are now commonly included in microcontrollers. A dual UART or DUART combines two UARTs into a single chip. Many modern ICs now come with a UART that can also communicate synchronously; these devices are called

USARTs.The Universal Asynchronous Receiver/Transmitter (UART) controller is the key component of the serial communications subsystem of a computer. The UART takes bytes of data and transmits the individual bits in a sequential fashion.

MAX232:

The MAX232 is an integrated circuit that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals. The drivers provide RS-232 voltage level outputs (approx. ± 7.5 V) from a single + 5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS-232 in this case.

The receivers reduce RS-232 inputs (which may be as high as ± 25 V), to standard 5 V TTL levels. These receivers have a typical threshold of 1.3 V, and a typical hysteresis of 0.5 V.

PIR SENSOR:

Figure 5.5 shows PIR is a piezoelectric sensor module which developed for human body detection. A PIR detector combined with a Fresnel lens are mounted on a compact size PCB together with an analog IC, SB0061, and limited components to form the module. High level output of variable width is provided.

Figure 8 PIR Sensor

Features and Electrical Specification:

1. Compact size (28 x 38 mm)
2. Supply
3. Voltage Output: High/Low level signal : 3.3V (Other choice: Open-Collector Output)
4. TTL output
5. High sensitivity
6. Delay time : 5s-18 minute
7. Blockadetime : 0.5s -50s (acquiescently 0seconds)
8. Operation Temperature: -15oC -70Oc
9. Infrared sensor: dual element

Lens information:

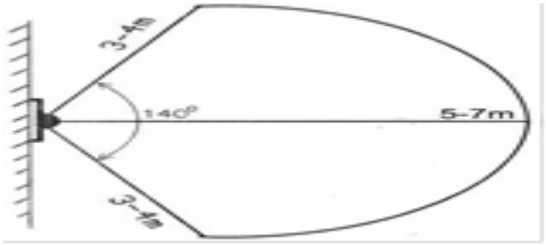

Figure 9.1 Range Angle

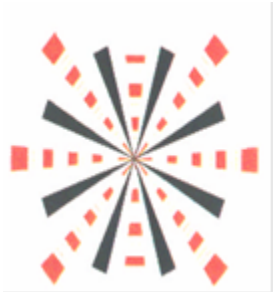

Figure 9.2 Centre

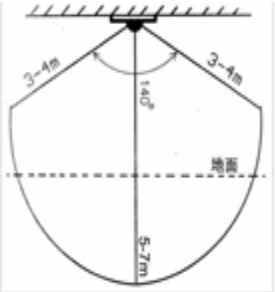

Figure 9.3 Vertical view

Note

Due to the high sensitivity of PIR sensor device, it is not recommended to use the module in the following or Similar condition.

A) In rapid environmental changes.

B) In strong shock or vibration.

C) In a place where there are obstructing material (e.g. glass) through which IR cannot pass within detection area.

D) Exposed to direct sun light.

WIRELESS SENSOR NETWORK:

Figure 10 shows WSN is a specification for a suite of high level communication protocols using small, low-power digital radios based on the IEEE 802.15.4-2003 standard for Low-Rate Wireless Personal Area Networks (LR-WPANs), such as wireless light switches with lamps, electrical meters with in-home-displays, consumer electronics equipment via short-

range radio needing low rates of data transfer. The technology defined by the WSN specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth.

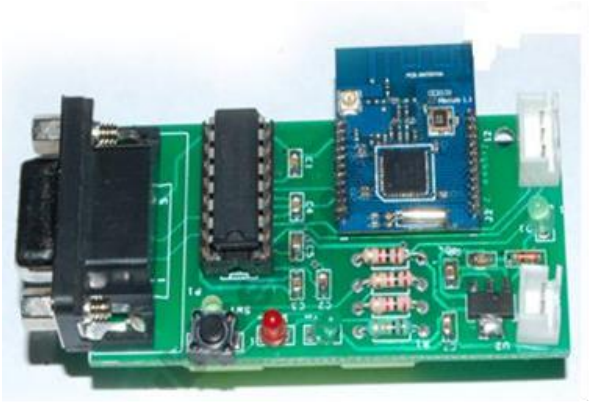

Figure 10

The relationship between IEEE 802.15.4 and WSN is similar to that between IEEE 802.11 and the Wi-Fi Alliance. The WSN 1.0 specification was ratified on 14 December 2004 and is available to members of the WSN WSN operates in the industrial, scientific and medical (ISM) radio bands; 868 MHz in Europe, 915 MHz in the USA and Australia, and 2.4 GHz in most jurisdictions worldwide. The technology is intended to be simpler and less expensive than other WPANs such as Bluetooth. WSN chip vendors typically sell integrated radios and microcontrollers with between 60 KB and 256 KB flash memory. Radios are also available as stand-alone components to be used with any processor or microcontroller. Generally, the chip vendors also offer the WSN software stack, although independent ones are also available. Because WSN can activate (go from sleep to active mode) in 30 msec or less, the latency can be very low and devices can be very responsive — particularly compared to Bluetooth wake-up delays, which are typically around three seconds. [3] Because WSNs can sleep most of the time, average power consumption can be very low, resulting in long battery life. The first stack release is now called WSN 2004. The second stack release is called WSN 2006, and mainly replaces the MSG/KVP structure used in 2004 with a "cluster library". The 2004 stack is now more or less obsolete.

ULTRASONIC SENSOR:

Ultrasonic sensors (also known as transceivers when they both send and receive) work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object.

This technology can be used for measuring: wind speed and direction (anemometer), fullness of a tank and speed through air or water. For measuring speed or direction a device uses multiple detectors and calculates. The technology is limited by the shapes of surfaces and the density or consistency of the material. For example foam on the surface of a fluid in a tank could distort a reading.

Figure 11 Ultrasonic sensor

Figure 11 shows Ultrasonic Electronic Eye Telemeter Module Through the technology of non-contacted ultrasonic measurement; ultrasonic electric telemeter module can measure a distance within 0.03-3m effectively.

PRODUCT HIGHLIGHT:

1. High sensitivity.
2. Narrow fade zone.
3. Quick response.

4.5V DC Supply voltage.

5. Compact sized SMD design.
6. Modulated at 40 kHz.
7. Serial data of 9600 bps TTL level output for easy interface with any microcontroller.
8. Accuracy of +-1cm.
9. Ultrasonic intelligence processing technology.

POWER SUPPLY:

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU.

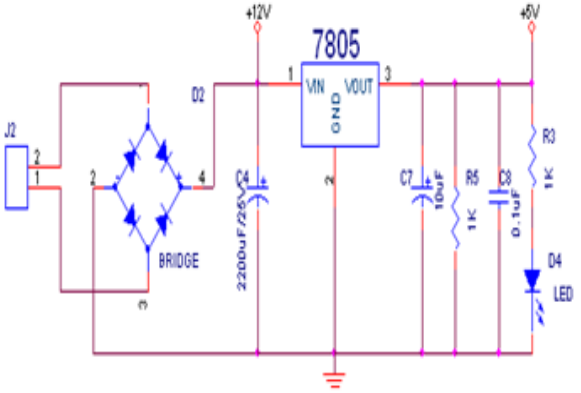

Figure 12 Power supply

The above figure 12 consists a 230v, 50Hz Single phase AC power supply is given to a step down transformer to get 12v supply. This voltage is converted to DC voltage using a Bridge Rectifier.

HISTOGRAM:

An image histogram is a type of histogram that acts as a graphical representation of the tonal distribution in a digital image. It plots the number of pixels for each tonal value. By looking at the histogram for a specific image a viewer will be able to judge the entire tonal distribution at a glance. Image histograms are present on many modern digital cameras. Photographers can use them as an aid to show the distribution of tones captured, and whether image detail has been lost to blown-out highlights or blacked-out shadows. This is less useful when using a raw image format,.The horizontal axis of the graph represents the tonal variations, while the vertical axis represents the number of pixels in that particular tone. The left side of the horizontal axis represents the black and dark areas, the middle represents medium grey and the right hand side represents light and pure white areas. The vertical axis represents the size of the area that is captured in each one of these zones. Thus, the histogram for a very dark image will have the majority of its data points on the left side and center of the graph. Conversely, the histogram for a very bright image with few dark areas and/or shadows will have most of its data points on the right side and center of the graph.

RELAY:

Figure 13 shows a relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal.

Figure 13 Relay

The main operation of a relay comes in places where only a low-power signal can be used to control a circuit. It is also used in places where only one signal can be used to control a lot of circuits. The application of relays started during the invention of telephones. They played an important role in switching calls in telephone exchanges. They were also used in long distance telegraphy. They were used to switch the signal coming from one source to another destination. After the invention of computers they were also used to perform Boolean and other logical operations. The high end applications of relays require high power to be driven by electric motors and so on. Such relays are called contactors.

EDGE DETECTION:

Edge detection is the name for a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges. The edges extracted from a two-dimensional image of a three-dimensional scene can be classified as either viewpoint dependent or viewpoint independent. A viewpoint independent edge typically reflects inherent properties of the three-dimensional objects, such as surface markings and surface shape. A typical edge might for instance be the border between a block of red color and a block of yellow. In contrast a line (as can be extracted by a ridge detector) can be a small number of pixels of a different color on an otherwise unchanging.

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