An Algorithm Design to Implement Swarm Robotics in the Next Generation of Technology

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Abstract— The new exploration of swarm robotics is dependent on the theme of austerity and elegance that resonates in both the designs and algorithms devised for the systems of the robots. The idea that complex macro level behaviors can emerge from simple local interactions between the agents is what the algorithms are based on. Several robotics enactment of this pattern confirms that these properties can be exploited for the control of a population of physically autonomous mobile robots. Swarm robotics is a new technical approach to the coordination of large numbers of relatively simple robots which takes its inspiration from social insects. Ant colony optimization (ACO) is a kind of conventional swarm intelligence .Swarm robotics is a new approach to the coordination of multi-robot systems which consist of large numbers of relatively simple robots which takes its inspiration from social insects .The algorithms dealt in this paper are explained on the basis of two projects where in the technical and practical aspects are examined based on the theoretical approach. The research in this field is not always accurate, though they have been useful to the research community. This paper interprets and gives overview of the two largest swarm robotics projects. The IROBOT swarm and the swarm robots projects, in which robots are made manually. Self-modeling and self-assembling of a swarm robot using a particular algorithm is explained in this particularly paper.

Key words: swarm intelligence, IROBOT, AntColony Optimization

I. INTRODUCTION

Swarm robotics is a new field, which is focused on controlling large scale homogenous multi robot systems. These Systems are made of modules that are simplified and compact in terms of design and size. These properties allow robot swarms to range from a dozen modules to a hundred. The research of swarm robotics is based on the theme of simplicity and elegance that resonates in both the designs and algorithms devised for the systems of the robots. The idea that complex macro level behaviors can emerge from simple local interactions between the agents is what the algorithms are based on.

The inspiration of this paradigm is from the observations of social insects such as ants, for they are not very intelligent and don't have a centralized control, and yet they perform complex colony level behavior such as foraging of food, migrating, building of bridges etc. The complex individual robot counterparts and the combining of more numbers of robotic swarms is valuable. Robot modules are less expensive and easier to build; thus, their design is straightforward. To judge the performance of the swarm robot to an individual robot is its individual entity performing complex behavior at the macro level. The obvious improvement observed is to cover more area than an individual robot. This is an analogous, for it covers different parts of a search space at once, by using the distributed search algorithm. Another improvement observed is the swarm robotics algorithms do not require the dependence of robots on each other thus the swarm robots are fault tolerant compared to an individual robot.

The most extremely important feature in hostile or complex environments is the robustness. Their effectiveness scales well enough with more number of members in robot swarms. To increase the effectiveness of a swarm, all that has to be done is to add, more robots. But, the improvement of the effectiveness of an individual robot is not clear, because the hardware improvement requires software that is upgraded which is not in case of swarms. Thus, these properties of a swarm robot can make multi robot system suitable for application domains.

II. LITERATURE SURVEY

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Proposed the working of swarm robots in which they have total three robots one master robot and two slave robots. They are design in such a way that they can undergo in terrain condition too. This technology was dealing with group formation and working of swarms where if one master robot fails the slave robots continue to communicate further.

B. Nouyan, S., Groß, R., Bonani, M., Mondada, F, and Dorigo, M. Group transport along a robot chain a self-organized robot colony. In Proc. of the 9th Int. Conf. on Intelligent Autonomous Systems (2006), IOS Press, Amsterdam, the Netherlands, pp. 433–442

Analyzed swarm intelligence control mechanism for solving problems of robots path formation. They determine the impact of two parabolicity control parameters which robots can function with the group and perform the difficult task.

C. Hettiarachchi, S., and Spears, W. Moving swarm formations through obstacle fields. International Conference on Artificial Intelligence (2005).

Proposed a novel framework called "Distributed Agent Evolution with Dynamic Adaptation to Local Scenarios"(DAEDALUS),for engineering multiagent systems that can used either onlineor offline,they explore the global aggregate behavior by examining the case study in the robotics swarms.

III. BLOCK DIAGRAM

We are about to use Wireless transreceiver (CC2500) for wireless data transmission and control of the robot. The microcontroller will make the decision as per the algorithm embedded in the system and generate the digital command to the motor driver for its operation and control of the robot. The entire module will be working in the group of swarms where the group of robots will be working at the same time with effective speed.

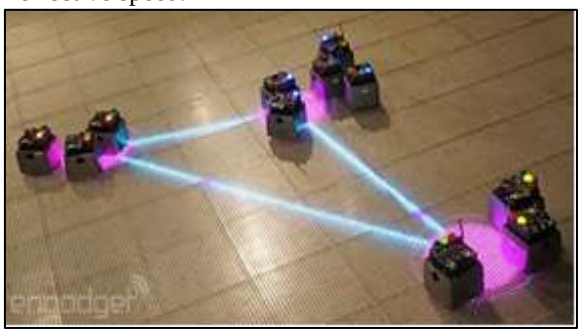


Fig. 1(a): An Overview of Swarm Robotics System

If in case one of the robots fails to perform the task it may delay the work performance but the working of other robots will be in the synchronized manner. The exact working of swarm intelligence will work again in the order after the signals are transmitted to the receiving module of failure maintenance .this whole process will take some amount of time to completed but according to the technology adapting in this circuit the performance of entire system will not be halt at any condition.

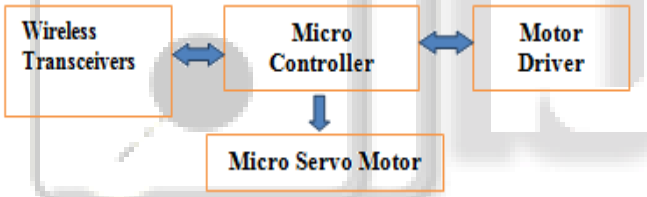


Fig. 1(b): Block Diagram of Robot

A. *Wireless Transceiver (CC2500 module):*

CC2500 is wireless transmitter receiver developed by Texas instruments which is used in 2400-2483.5 MHz ISM/SRD band systems. The CC2500 RF module is a low-cost 2.4 GHz transceiver used in very low power wireless applications. The RF transceiver is integrated with a highly configurable baseband modem. It support OOK, 2-FSK, GFSK, and MSK modulations. It works in voltage range of 1.8 - 3.6V.

B. *Microcontroller:*

ATmega16 is an 8-bit high performance microcontroller of Atmel's Mega AVR family with low power consumption. Atmega16 is based on enhanced RISC (Reduced Instruction)RISC and CISC Architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. Atmega16 can work on a maximum frequency of 16MHz.It has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes. The endurance cycle of flash memory and EEPROM is 10,000 and 100,000, respectively. ATmega16 is a 40 pin microcontroller. There are 32 I/O (input/output) lines which are divided into four 8-bit ports designated as PORTA, PORTB, PORTC and PORTD. ATmega16 has various in-built peripherals like USART, ADC, Analog Comparator, SPI, JTAG etc. Each I/O pin has an alternative task related to in-built peripherals.

C. *Motor Driver:*

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. H-bridge is a circuit which allows the voltage to be flown in either direction. H-bridge IC are ideal for driving a DC motor. Due its size it is very much used in robotic application for controlling DC motors.

There are 4 input pins for l293d, pin 2,7 on the left and pin 15 ,10 on the right as shown on the pin diagram. Left input pins will regulate the rotation of motor connected across left side and right input for motor on the right hand side. The motors are rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1. For rotating the motor in clockwise direction the input pins has to be provided with Logic 1 and Logic 0.Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their input.

D. *Micro Servo Motor:*

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration.[1] It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

Servomotors are not a specific class of motor although the term *servomotor* is often used to refer to a motor suitable for use in a closed-loop control system. Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing.

A servomotor is a closed-loop servomechanism that uses position feedback to control its motion and final position. The input to its control is a signal (either analogue or digital) representing the position commanded for the output shaft.

E. *Language Used:*

1) *Embedded C:*

a) Why c?

C was originally developed by Dennis Ritchie between 1969 and 1973 at Bell Labs,[6] and used to re-implement the Unix operating system.[7] It has since become one of the most widely used programming languages of all time,[8][9] with C compilers from various vendors available for the majority of existing computer architectures and operating systems. C has been standardized by the American National Standards Institute (ANSI) since 1989 (see ANSI C) and subsequently by the International Organization for Standardization (ISO).

C is an imperative procedural language. It was designed to be compiled using a relatively straightforward compiler, to provide low-level access to memory, to provide language constructs that map efficiently to machine instructions, and to require minimal run-time support.

Despite its low-level capabilities, the language was designed to encourage cross-platform programming. A standards-compliant and portably written C program can be compiled for a very wide variety of computer platforms and operating systems with few changes to its source code.

IV. WORKING

1) The swarm modules uses the encoding technique which calculates the total number of steps to be performed for achieving the task .This handles communication obstacle avoidance and localization.
2) Robots determine the shortest path locations and bearings of each other, when they are in close proximity. And communication is possible.
3) The message is passed on through a gradient based multi hop messaging protocol that cause to scatter throughout the swarm.
4) Messages flow through the mesh network topology which changes constantly, following a particular characteristic gradient. The entire process of system prototype using the technology of swarm intelligence.

V. ALGORITHM

The working algorithm of this system is divided into 4 steps which shows the of working of module in entire system from source to destination.

1) Step 1) when the wireless signals are activated the data is received.
2) Step 2) If wireless data is true the bots will operate on command mode following the shortest path.
3) Step 3) If bot is encounter with obstacles it will halt in middle of the path, and if condition is false it will move towards the destination side.
4) Step 4) If wireless data communication fails between the master and slave it will instruct again for data transmission at the control side. Hence the wireless communication mode is activated again.

VI. TOOLS & SOFTWARE USED

A. *Tools:*

The other requirements which are used in this module is as follow

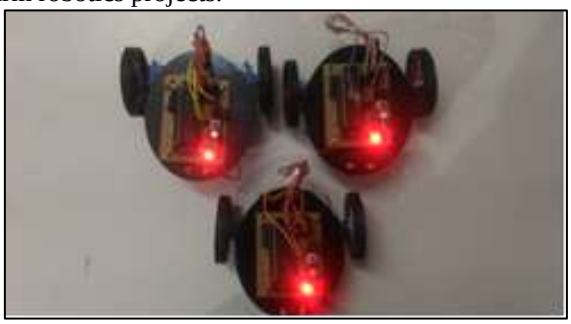
1) Mechanical Accessories such as Wheels /Chassiss/Arm gripper
2) DC Battery 12V
3) IC 7805
4) LED

B. *Software Used:*

1) AVR studio
2) PCB Artist
3) Win AVR

VII. RESULTS

Swarm robotics brings several issues that can be addressed in the future lines of research. Lack of global knowledge can lead to a deadlock, and the group of robots cannot progress.Leaving Science Fiction aside, the expectations concerning intelligent robotic technology development over the next decade or so are quite modest. The practical application domains where robotic technology is most likely to be used. The research in this field is not always accurate, though they have been useful to the research community. This paper interprets and give overview of the two largest swarm robotics projects.



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