Development of Swarm Robots

A N Jyothi Shreeram Dutt, A Rahul, Abhishek Sarkar,

A John Anvesh, Prof. Dilna U

School of ECE,REVA UNIVERSITY, Bengaluru

ABSTRACT

Swarm robotics is currently one of the most important application areas for swarm intelligence. Swarms provide the possibility of enhanced task performance, high reliability (fault tolerance), low unit complexity and decreased cost over traditional robotic systems. They can accomplish some tasks that would be impossible for a single robot to achieve. Swarm robots can be applied to many fields, such as flexible manufacturing systems, spacecraft, Inspection/maintenance, construction, agriculture, and medicine work. Swarm-bots are a collection of mobile robots able to self-assemble and to self-organize in order to solve problems that cannot be solved by a single robot. These robots combine the power of swarm intelligence with the flexibility of self-reconfiguration as aggregate swarm-bots can dynamically change their structure to match environmental variations.

Keywords: *Artificial Intelligence, Master-Slave Configuration, Mobile Robots, Self-Reconfiguration, Swarm Intelligence*

I. INTRODUCTION

Sometimes it is impossible to complete a task by a single person or it becomes quite difficult for that person to complete the work. In such cases there is need of a team or group of members that can collaboratively work and make the work of the person or the user easy. The concept of the SWARM ROBOTICS is based on this basis of grouping of multiple robots or devices and performing the desired task.

The Concept Swarm robotics is implementation of Swarm intelligence. Swarm Intelligence (SI) is an artificial intelligence technique based around the study of collective behavior in decentralized, self organized systems. Swarm robotics is a new approach to the coordination of multi-robot systems which consist of large numbers of mostly simple physical robots .It is supposed that a desired collective behavior emerges from the interactions between the robots and interactions of robots with the environment. This approach emerged on the field of artificial Swarm intelligence, as well as the biological studies of insects, ants and other fields in nature, where swarm behavior occurs. The main objective of Swarm robotics is to reduce the work load and increase the efficiency of the system.

Swarm robots are more than just networks of independent agents, they are potentially reconfigurable networks of communicating agents capable of coordinated sensing and interaction with the environment. Robots are going to be an important part of the future. In the near future, it may be possible to produce and deploy large numbers of inexpensive, disposable, meso scale robots. Although limited in individual capability, such robots deployed in large numbers can represent a strong cumulative force similar to a colony of ants or swarm of bees. Once robots

are useful, groups of robots are the next step, and will have tremendous potential to benefit mankind. Software designed to run on large groups of robots is the key needed to unlock this potential.

The intent of this research is to leverage on agent based simulation to model a ground robotic swarm on a search and detection mission in a semi-urban environment rigged with stationary IEDs. Efficient design of experiment techniques and data farming are engaged to help identify controllable factors and capabilities that have the most impact on overall effectiveness.

II. RELATED WORK

MicaelS.Coucerio et al.,[1] Introduced the idea of "A low cost education platform for Swarm Robots" to maintain low cost robot design, denoted as E-Swarm robot which specifically targets engineering education and Swarm Robots. AleksandarJevtic et al.,[2] introduced the idea of "Swarm Intelligence and its applications in Swarm Robotics" which is an interesting alternative to classical approaches to robotics because of their problem solving capability.J.H. Lee et al., [3] introduced the idea of "Improving energy efficiency in cooperative foraging swarm robots using behavioral model" which adopt a new behavioural model regarding role division and search space division for improving energy efficiency. AriSantoso et al., [4] introduced "A New Obstacle Avoidance Method for Service Robots in Indoor Environments" where an obstacle avoidance method for service robots in indoor environments using vision and ultrasonic sensors. Ramdane Hedjaret al.,[5] suggested the idea of "Real Time Obstacle Avoidance for Swarm of Autonomous Mobile Robots" presents a collision-free path planning using nonlinear optimization combined with one-step-ahead predictive controller. Vaghela Ankit et al., [6] introduced the idea of "Obstacle Avoidance Robotic Vehicle Using Ultrasonic Sensor, Android And Bluetooth For Obstacle Detection" which uses multiple components to detect an obstacle and avoid it.SitiNurmaini et al., [7] presented a "Intelligent Low Cost Mobile Robot and Environmental Classification" an autonomous mobile robot based on FKN is proposed which has been developed for low-cost application platform.

III. PROPOSED WORK

3.1 Working of SWARM robots

Swarm robotics is a new approach to the coordination of multi-robot systems which consist of large numbers of mostly simple physical robots .It is supposed that a desired collective behavior emerges from the interactions between the robots and interactions of robots with the environment. The main objective of Swarm robotics is to reduce the work load and increase the efficiency of the system. Swarm-bots are a collection of mobile robots able to self assemble and to self organized in order to solve problems that cannot be solved by a single robot. These robots combine the power of swarm intelligence with the flexibility of self reconfiguration as aggregate swarm-bots can dynamically change their structure to match environmental variations.

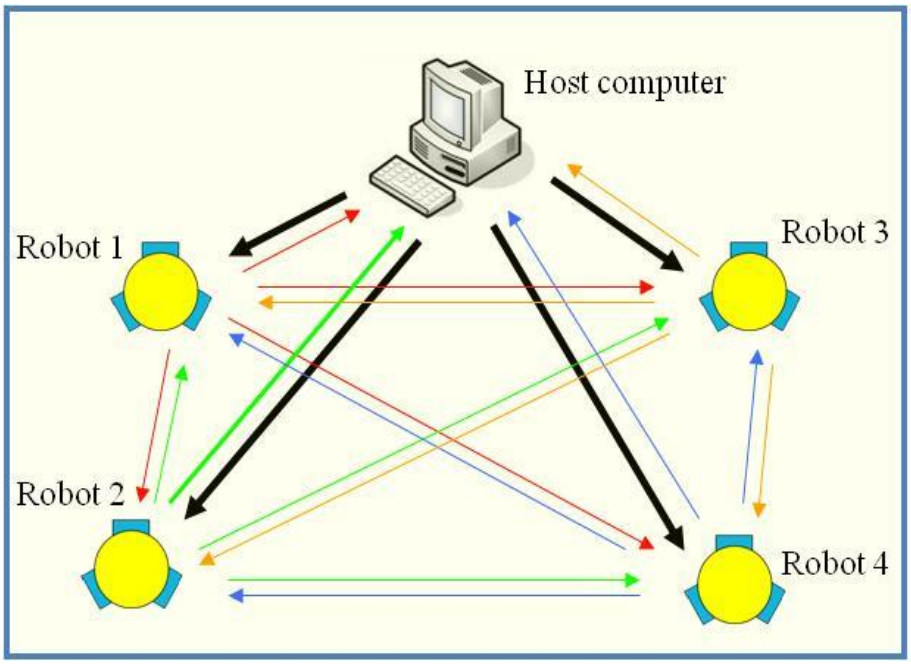

Fig 3.1 Block diagram

3.2 Working of Arduino Software IDE

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.

3.3 THE HARDWARE SETUP

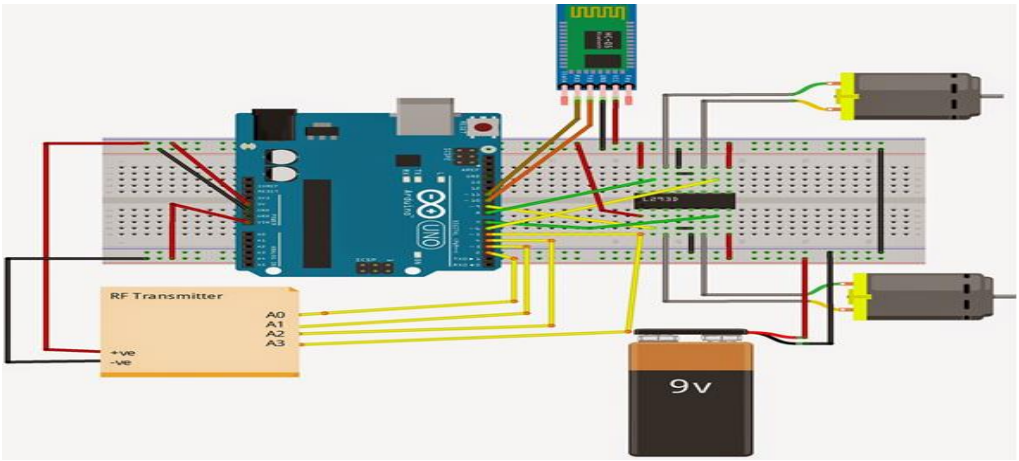

Fig 3.3.1 Master circuit

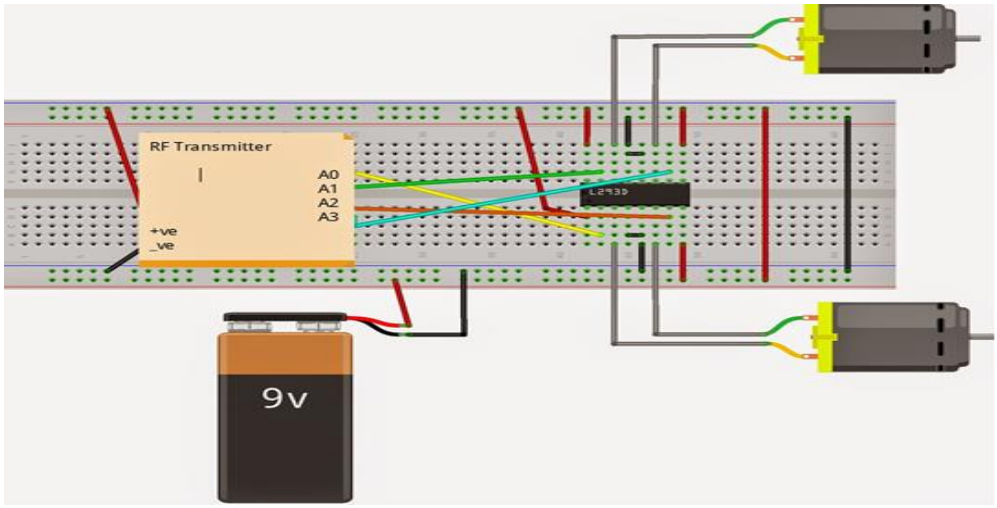

Fig 3.3.1 Slave circuit

The hardware design for any swarm is an interactive and an important phase, as all components and/or parts are assembled to build one robot swarm. At the hardware level, the most work has been done in collective behavior with homogeneous robots. In this project we decided to exploit reconfigurability and modularity using heterogeneous robots with decentralized control algorithms, which are influenced by the behaviors of ants, bee colonies, and insects in general.

IV. HARDWARE AND SOFTWARE REQUIREMENTS

Table:4.1 Hardware and Software requirements

HARDWARE REQUIREMENT	SOFTWARE REQUIREMENT
1. Arduino UNO R3 (Atmega 328-P Microcontroller). 2. Motor Driver Module (L293D). 3. Ultrasonic Sensor (HC-SR04). 4. Bluetooth Module (HC-05). 5. Battery (9 V) . 6. Robot chasis. 7. Male-to-male connector. 8. Male-to-female connector. 9. BNC cable.	1. Arduino Software IDE (version 1.8.5).

VI. CONCLUSION

As the technology is spreading in extremely high speed, every area in a technology needs to be reformed or else the survival of that technology is hugely impossible. This paper highlights work on one of the fundamental function of the robots i.e. obstacle detection and avoidance applied to a set of robots (which is swarm robotics) using Arduino Uno. Here the sensor detects any obstacle and avoids it and the same information will transmitted to the other robots to avoid the obstacles, thus the major objective of autonomous swarm robots will be solved. Using the concept of 'Swarm Robotics' less number of robots can complete the assigned task collectively in less amount of time which also in turn increases the efficiency and the output at same time reducing the cost.
Disaster rescue missions are one of the most important applications of swarm's robots. Swarms of robots of could be sent to places rescue workers can't reach this would save lives.Swarm robots are also useful for autonomous surveillance and environment monitoring to investigate environmental parameters, search for survivors, and locate sources of hazards such as chemical or gas spills, toxic pollution, pipe leaks, radioactivity.

REFERENCES

[1]. R. Lundhetal, **"Automatic Configuration of Multi-Robot Systems: Planning for Multiple Steps"**, Proceedings of the European Conference on Artificial Intelligence, 2008.

[2]. G. Kumar, V. Vijayan, **"A Multi-agent Optimal Path Planning Approach to Robotics Environment"**, International Conference on Computational Intelligence and Multimedia Applications, 2007.

[3]. I.A. Nesnas, **"CLARATY: A Collaborative Software for Advancing Robotic Technologies,"** NASA Science and Technology Conference, June 2007.

[4]. G. Beni, **"From swarm intelligence to swarm robotics,"** in Swarm Robotics Workshop: State-of-the-Art Survey, E. Sahin and W. Spears, Eds., no. 3342, pp. 1–9, Springer, Berlin, Germany, 2005.

[5]. N.Y. Chongetal, **"Robots on Self Organizing Knowledge Networks",** Proceedings of International Conference on Robotics and Automation, 2004.