Swarm Intelligence for group task automation

Karthik S[1], Madan BL[2], Shivarama Reddy[3], Keerti Kulkarni[4]
[1,2,3]*Department of ECE, BNM Institute of Technology, Bangalore*
[4]*Asst. Prof, Department of ECE, BNM Institute of Technology, Bangalore*

***Abstract* - Swarm intelligence is a new research territory propelled from organic framework, for example, insect. Swarm robotics, which is based on swarm intelligence is a part of multi-robot frameworks that grasp the thoughts of natural swarms like bees. In this work, self-get together robots are utilized to move to the material starting with one spot then onto the next by swarm intelligence (SI). In swarm intelligence, when one robot cannot finish the task by itself, it will ask the assistance of the other robots in the swarm. This automated framework will be helpful in dangerous material taking care of, clearing minefields, secure a territory without putting life in danger. Additionally, the military, law enforcement and private security firms could be profited by this framework. In the conventional strategy the robots are working individually, but in this proposed framework, the multi-robot will team up with one another and functions as a group as opposed to single robots. Swarm robot, with its self-gathering ability opens up new research related to self-reconfigurable and aggregate robots. The idea consolidates equipment adaptability found in self-reconfigurable robot with control flexibility found in disseminated control for aggregate robotics. In addition, we are supplanting the wheel development with the components since the wheel development is just constrained to the uniform territories however with assistance of Klann's mechanism the robot, can get to the harsh landscapes.**

***Index Terms* - Swarm Intelligence, swarm robot, task automation, Klann's mechanism.**

I.INTRODUCTION

Nature has constantly motivated specialists. By just watching, we can notice the examples, the arrangement of guidelines that make apparently disorganized procedures sensible. How would we think and how would we remember? For what reason is advancement so significant for the survival of species? How do social creepy crawlies realize how to pursue the way to a wellspring of sustenance without worldwide information? These inquiries are incompletely replied by computational intelligence (CI). Swarm intelligence tries to incorporate this natural survival mechanism of the swarms of insects. The expression "swarm" is utilized to allude to "a huge gathering of locally interfacing individual with shared objectives". Swarm robotics frameworks, just as their organic partners, comprise of numerous individuals showing basic practices. While executing these basic practices, individual is fit for delivering complex aggregate practices on the swarm level that no individual can accomplish alone. Swarm robotics frameworks are described by local sensing and correspondence abilities, parallelism in task execution, robustness, scalability, heterogeneousness, adaptability and decentralized control. A few specialists infer that even basic inactive substances, (for example, rice) can deliver fascinating practices (i.e., structure designs) whenever animated by an outer power. The goal of SI (Swarm intelligence) is to display the basic conduct of the individual, their nearby communications with nature and neighbouring individual, so as to get progressively intricate practices that can be utilized to take care of complex issues, for the most part enhancement issues. The exploration of swarm robotics is to contemplate the plan of robots, their physical body, and their controlling practices. Much research has been aimed at this objective of effortlessness at the individual robot level. Having the option to utilize genuine equipment in the exploration of Swarm Robotics as opposed to reproductions enables analysts to experience and resolve a lot more issues and expand the extent of Swarm Research. In this manner, the improvement of straightforward robots for Swarm intelligence research is a significant part of the field.

II.LITERATURE SURVEY

An overview of the swarm robotics and its application was given by Mohan and Poonambalam (2009). Apart from the regular scenario of the master slave configuration on which a majority of the works are based, Zhu and Yang (2010) have introduced a self-organizing map (SOM) based approach for multiple robot systems. The same authors (2006) have used a neural network approach to the assignment of tasks to multiple robots. Akkiraju et., al (2001) have discussed a scheduling mechanism for assigning the tasks to the robots. Starke et. al (1998), have discussed the self-organizing behaviour of the swarm robots. Beard et., al (2002) have discussed a similar mechanism for unmanned aerial vehicles.

III.PROBLEM STATEMENT

In this work, an object has to be pushed to the destination using a group or swarm of robots. The object is such that an individual robot will not be able to move the object on its own. The work described here provides an automated framework to achieve this objective.

IV.METHODOLOGY

Figure 1 to Figure 11 show the position and the communication exchanged between the robots through the microcontroller. Initially, the object and all the three bots are in the state of rest as shown in Figure 1. There are two sensors, Object Moved sensor, which keeps a track of the movement of the object and the Object Reached sensor, which senses when then object reaches the destination.

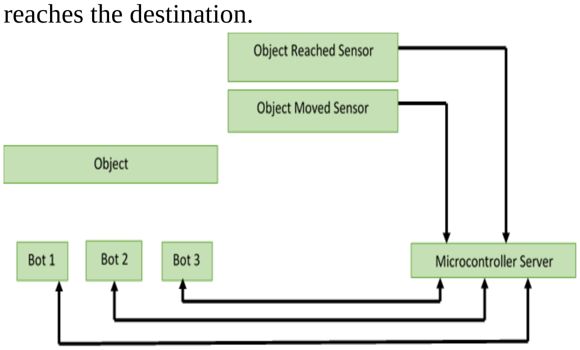

Figure 1: Initial position of the swarm robots and the object

All robots are associated with one another by methods of a Wi-Fi module which is associated with each robot. The robots are constrained by the Server (Microcontroller) by methods for Wi-Fi. All robots are put sequentially. An ultrasonic sensor is put on the main robot (for example Wi- Fi bot 1) just as on the underlying goal (for example item moved sensor) and last goal (for example item achieved sensor). An item with specific weight is set in front the Wi-Fi robots and parallel to beginning goal

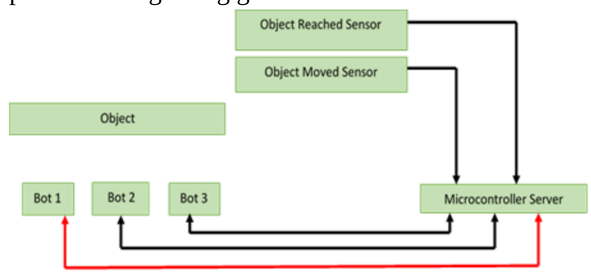

Figure 2: Robot 1 pushing the object

As the main bot is associated with an ultrasonic sensor, the sensor will continue distinguishing any item before it. When we keep an article before the sensor, it will recognize an impediment in its range and the disjoin will order the robot to move forward way by means of Wi-Fi.

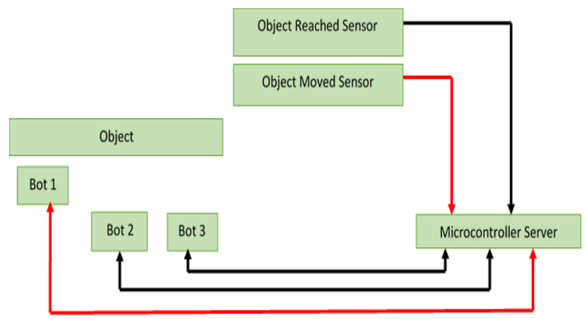

Figure 3: Robot 2 gets instruction from the server to move forward

When the bot 1 interacts with the object it will endeavour to drive it forward (Figure 3). On the off chance that it is effective in pushing the item, it will continue pushing the article up till its last goal. If not it, the ultrasonic sensor at starting goal will sit tight for certain secs and will offer sign to the server for next order. If the bot-1 is not able to push the object by itself, it asks the help of bot-2 through the microcontroller (Figure 4). Figure 5 indicates a scenario when both bot-1 and bot-2 are pushing the object together.

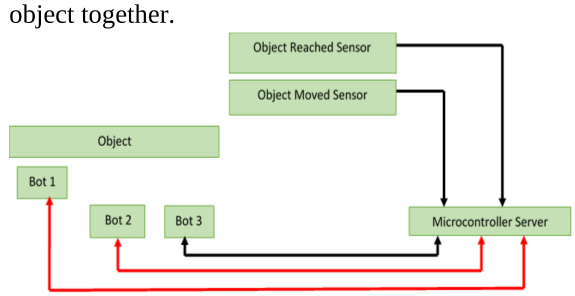

Figure 4: Robot 2 gets instruction and assist robot-1

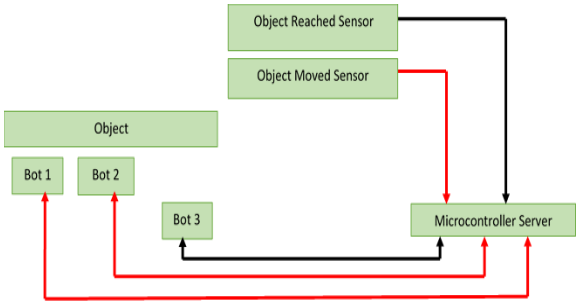

Figure 5: Both robot-1 and robot-2 push the object together

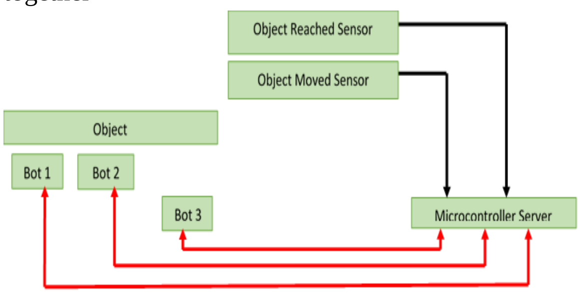

Figure 6: Robot 3 get instruction to assist robot 1 & 2

After that the third robot will be told to push ahead and all together (Figure 7) will endeavour to push the object to its last goal (Figure 8). When the object compasses to its last goal. The ultrasonic sensor at conclusive goal will distinguish the nearness of the item and will direction the server to educate every one of the robots to return back to its last goal. In this way, as every one of the robots have gets the direction from microcontroller server through Wi-Fi then the article is being moved by every one of the robots.

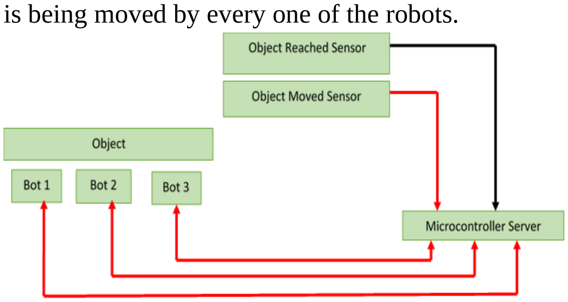

Figure 7: Robots moving the object

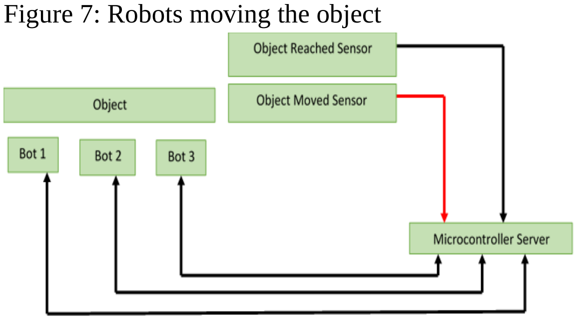

Figure 8: object moved sensor sends the sign to the microcontroller.

As the object is pushed toward the required area and the object moved sensor sends the sign to the microcontroller (Figure 9). After the object spans to the required area the item achieved sensor sends the sign to the microcontroller. The microcontroller in turn sends a sign to the bots to go back to their original positions (Figure 10). Figure 11 shows when all the robots come back to their original places.

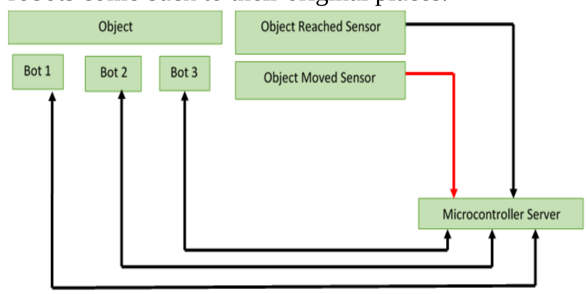

Figure 9: Object is moved to their require place

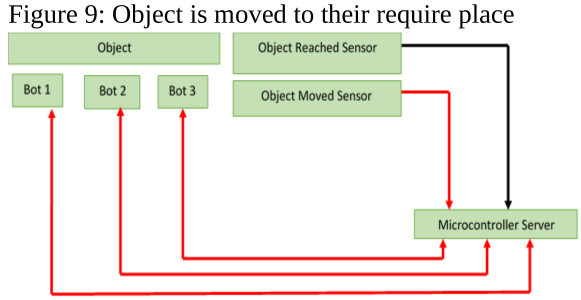

Figure 10: Instruction is given to all robot to move backwards

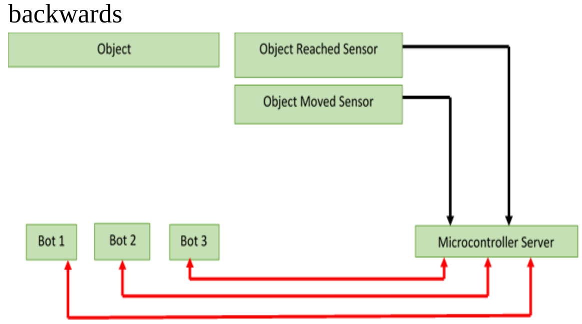

Figure 11: All robot come to their original place

V.EXPERIMENTAL RESULTS

We have made three robots, wherein two are basic robots and one in klann mechanism robot. The primary target is to demonstrate the correspondence between the robots which will be simply remote and to demonstrate that how the robots team up with one another to finish their work, in this case, the pushing of the material. The framework contains server which is the principal component and includes two ultrasonic sensors. The working is described in 3 different cases.

Case 1: If the fundamental robot which comprise of klann system robot pushes the object on its own, then there is no need for any help from the other robots of the swarm.

Case 2: If in the event that the principal robot is unfit to move the article past the primary sensor then the server will activate the second robot after 25 secs, which will endeavour to assist the fundamental robot with moving item to its last area. After the object has come to its last area the server will send the sign to both the robot to go in reverse.

Case 3: If on the off chance that both the robot (principal robot and second robot) is unfit to move the article then server will incite the third robot which will help the primary and the second robot to move the item to its last position. After the task is achieved, the server will send the sign to all robot to move back to their original places.

VI.CONCLUSIONS

This work has given an outline of swarm intelligence research and its applications in swarm robotics. Swarm robotics is an intriguing option in contrast to traditional ways to deal with robotics for task-automation. This work demonstrates the teamwork of the robots to move an object to its final destination.

REFERENCES

[1] V. B.Bhandari,“Design of machine element”, published by McGraw hill education private limited, third edition 2013, page no. 646-690.

[2] Yogeswaran Mohan, S. G. Ponnambalam, “An Extensive Review of Research in Swarm Robotics”, Nature & Biologically Inspired Computing, 2009, DOI: 10.1109/NABIC.2009.5393617

[3] Aleksandar Jevtic, Diego Andina, “Swarm Intelligence and its Applications in Swarm Robotics”, Universidad politecnica de Madrid E.T.S.I. Telecomunication spain, Dec. 2007, page no. 41-46.

[4] U.Vanitha, V Premalatha, “Mechanical Spider Using Klann Mechanism”. International journal of Mechanical Engineering, Volume no. 5, Issue 3, March 2017, page no. 13-15.

[5] Urvil P Patel, “Design and Finite Element Analysis of Mechanical Spider”, International Journal of Science and Research (IJSR) ISSN, December 2015, Volume 4 Issue 12, page no. 1876-1880.

[6] N. G. Lokhande, V.B. Emche, “Mechanical Spider by Using Klann Mechanism”, International Journal of Mechanical Engineering and Computer Applications, Vol 1, Issue 5, Special Issue, October 2013, ISSN 2320-6349.

[7] Anmin Zhu, Simon X. Yang, “An Improved SOM-based Approach to Dynamic Task Assignment of Multi-robots”, Proceedings of the 8th World Congress on Intelligent Control and Automation, July 2010, Jinan, China, pp. 2168-2173.

[8] Aleksis Liekna, Janis Grundspenkis, “Toward practical application of swarm robotics: Overview of swarm tasks”, Engineering for rural development, Jelgava, 29.- 30.05.2014.

[9] Andrew Howard, Maja J Matari´c and Gaurav S Sukhatme, “An Incremental Self-Deployment Algorithm for Mobile Sensor Networks”, Robotics Research Laboratory, Computer Science Department, University of Southern California, Los Angeles, California, 90089- 0781, U.S.A, Autonomous Robots, Special Issue on Intelligent Embedded Systems, Sept2002, pp.113—126

[10] A. Zhu and S. X. Yang, "A neural network approach to dynamic task assignment of multi-robots", IEEE Transactions on Neural Network, vol. 17, no. 5, pp. 1278-1287, 2006.

[11] R. Akkiraju, P. Keskinocak, S. Murthy and F. Wu, "An agent-based approach for scheduling multiple machines", Applied Intelligence, vol. 14, pp. 135-144, 2001.

[12] J. Starke, M. Schanz and H. Haken, "Self-organized behavior of distributed autonomous mobile robotic systems by pattern formation principles" in Distributed Autonomous Robotic Systems 3, Berlin: Springer-Verlag, pp. 89-100, 1998.

[13] R. W. Beard, T. W. McLain, M. A. Goodrich and E. P. Anderszn, "Co-ordinated target assignment and intercept for unmanned air vehicles", IEEE Transaction on Robotics and Automation, vol. 18, no. 6, pp. 911-922, December 2002.