SWARM ROBOTICS

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Abstract: Swarm robotics is a new approach to the co-ordination of multi-robot system which consists of large number of relatively simple robots which takes its inspiration from social insects.The most remarkable characteristic of swarm robots are the ability to work co-operatively to achieve a common goal.Swarm robotics is considered to collective robotics that takes inspiration from behaviour of social animals.The term "swarm"hasbeen applied to many systems(in biology, engineering,computation, and so on)as they have some of the qualities that the English- language term "swarm"denotes with the growth of the various area of "swarm"terminology has become somewhat unclear.In this paper,we reflect an this terminology to help clarify its association with various robotic concepts.

Keywords: Interaction With Environments, Robust And Flexible, Multi-Tasking Swarm-Bots

I. INTRODUCTION

Swarm robotics is an advent in the coordination andmultitasking of multi-robot systems which consist of large numbers of mostly simple physical robots. This collective behaviour appears from the communication and interactions between the robots, interactions of robots with the environment and humans. The artificial swarm intelligence has been inspired by biological studies of behaviour of ants, bees, wasps and termites. This behaviour and perfect co-ordination has been the inspiration for changing the perspective on how robots were understood, andgives a new trend to theirfunctionality; such as solving problems through large population. Due to ever growing prices of foodstuffs and staple crops, we plan to introduce a simple autonomous system where swarm robots will reduce the cost, eliminate the majorproblem of unavailability of work-force, reduce waste of land drastically, increase productivity, constantly monitor the cropsthroughout its growth period. This system will be able to achieve a very high efficiency at a low cost. It also severelyincreases the productivity of the farmer and yields him high profits, with very less investment. The highly independentnature of this system adds to its user friendliness.It has practically zero maintenance issues. Hence, reducing cost of all the basic goods in the market which directly affects theeconomy of the nation. This system aims in providing faster, cheaper, real time cost current solutions.

The main characteristics of a swarm robotics system are the following:

- ✓ robots are autonomous;
- ✓ robots are situated in the environment and can act to modify it;
- ✓ robots' sensing and communication capabilities are local ;
- ✓ robots do not have access to centralized control and/or to global knowledge;
- ✓ robots cooperate to tackle a given task.

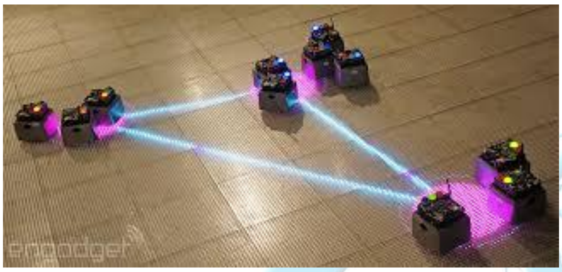
In this review, we use these characteristics to separate between the works that belong to swarm robotics from those that belong to other multi-robot approaches Slightly different characterizations of swarm robotics have been planned and accepted by S¸ahin (2005), Beni (2005) and Dorigo and S¸ahin (2004). The main inspiration for swarm robotics comes from the observation of social animals. Ants, bees, birds and fish are some examples of how simple individuals canbecome successful when they gather in groups. The interest towards social animals stems from the fact that they display a sort of swarm intelligence. In particular, the behavior of groups of social animals appear to be robust, scalable and flexible.

Robustness is the ability to manage with the loss of individuals. In social animals,robustness is promoted by redundancy and the absence of a leader. Scalability is the ability to perform well with different group sizes. The introduction or removal of individuals does not result in aalteration of the performance of a swarm. In social animals, scalability is promoted by local sensing and communication.

Flexibility is the ability to cope with a broad spectrum of different environmentsand tasks. In social animals, flexibility is promoted by termination, simplicity of the behaviors and mechanisms such as task allocation. A detailed analysis of robustness, scalability and flexibility in social animals has been carried out by Camazine et al. (2001).By taking inspiration from social animals, swarm robotics aims at developing robotics systems that display swarm intelligence features similar to those that characterize social animals. In particular, swarm robotics systems are meant to be robust, accessible and flexible.

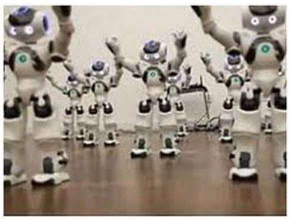
II.SWARM ENGINEERING

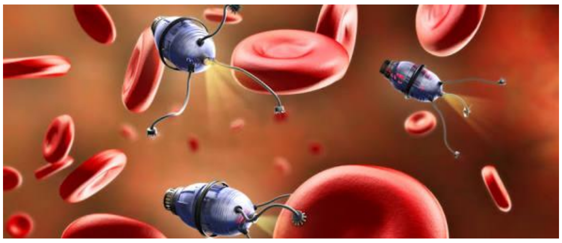
Swarm engineering is the systematic application of scientific and technical knowledgeto model and specify requirements, design, realize, verify, validate, operate and maintain a swarm intelligence system. Swarm engineering as a term was introduced by Kazadi, who recognized that the focus of swarm intelligence research is moving towards "the design of predictable, controllable swarms with well-defined global goals and provable slight conditions". He also adds that "to the swarm engineer, the important points in the design of a group are that theis not homogeneous. On the one hand, some topics, such as design and analysis, have already received attention from the swarm robotics community and several proceduresand tools have been proposed. In particular, we focus on ideas and solutions that promote the application of swarm robotics to real-world applications.



III.CURRENT RESEARCH AND DEVELOPMENT INMEDICAL ROBOTICS

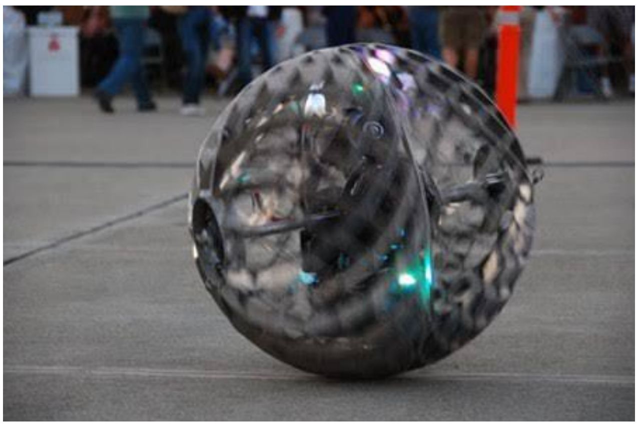
Many more medical robots are currently being researched. Such research will lead to the new capabilities of future commercial systems. *RAVEN and MiroSurge.* Two prominent academic robot-assisted surgical systems are currently used for research into endoscopic telesurger. The system has two patient-side arms that are cable-driven with 7 degrees of freedom each. The arm kinematics are based on a spherical mechanism such that the tool always passes through a remote center. The arms are lighter, smaller, and less expensive than current robotic systems for laparoscopy. The instrument controllers are haptic devices, allowing force feedback on the operator's hands based on tool forces or virtual fixtures defined with respect to patient anatomy Teleoperation experiments have been conducted with the RAVEN, including routing the data transmission through an unmanned aircraft. In another endoscopic research effort, the German Aerospace Center (DLR) is developing MiroSurge to be highly versatile with respect to the number of surgical areas, arm-mounting locations, number of robots, different control modes, and the ability to integrate with other technologies.



IV.TASKS OF THE SWARM

The potential applications of swarm robotics range from surveillance operations to mineenchanting in unfriendly environments .We believe it is essential to identify the tasks that can be solved using swarm robotics. According to recent literature reviews , swarm robotics has been studied in the context of the following tasks:*Aggregation* deals with spatially grouping all robots together in a region of the environment. Aggregation is used to get robots in a swarm sufficiently close together and can be used as a starting point for performing some additional tasks, such as communication with limited range. Research include *Pattern formation* considers robot disposition into environment forming some sort of geometric pattern such as a circle, a square, a line, a star, a lattice, etc. Pattern formation is useful in preserving communication range and helping to overcome environment limitations (e.g., forming a chain to pass a narrow passage). Pattern formation is studied in In *self-assembly* robots physically connect to each other to form a particular structure. Selfassemblyis used to increase the pulling power of the robots, provide stability to the robot swarm while moving on rough lands, form a connected structure to guide other swarm robots, assemble structures used to overcome holes that a single robot would fall into and to combine capabilities of heterogeneous robots. Self-assembly is studied in several large-scale research projects such as SWARM-BOT Symbrion, Swarmanoid and Replicator O*bject gathering and assembling* involves picking up objects that are spread across the environment and gathering or assembling them in specific regions. In s*warm-guided navigation* robots of the swarm are navigated by other members of the swarm.Robots are not aware of their actual location or the location of the target. Instead, the swarm is guided by directions supplied by previously deployed robots forming a communication relay.



V.CONCLUSION

In this paper we have summarized tasks that have been studied in the context of swarm robotics and discussed the practical applicability of these tasks. To take a next step towards practical application of swarm robotics, a research on combining multiple task types should be conducted. The task types studied in the context of swarm robotics can be considered the basic building blocks to produce more complex behaviours with bigger potential of practical applications. We agree with theconclusion of the authors in indicating that new research in swarm robotics should focus more on applications of the previous work. One of the possible steps in this direction is to combine studies in the existing task types to obtain new ones aiming at specific practical applications. For example, by combining the ideas of coordinated motion, obstacle avoidance and cooperative hole avoidance mightbe possible to produce “safe motion” behaviour. Combining mapping and besidesswarmguidednavigation would produce “safe navigation” behaviour. Combing safe navigation with safemotion would produce a swarm capable of safely travelling through environment while being aware ofthe position of individual robots. Such swarm has direct application in surveillance and patrollingapplications. This is just an example of the possibilities that can be exploited by combining differenttask types. We believe this research topic is of great potential.

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