IoT Based Swarm Home Robots Next Gen Maids
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Abstract: 
Swarm robotics is a relatively new research area inspired from biological systems such as ant or bee colonies. It composes a system consisting of many small robots with simple control mechanisms capable of achieving complex collective behaviors on the swarm level such as aggregation, pattern formation and collective transportation to name a few. The main motto of this paper is to incorporate the swarm technology in consumer electronics where these are used in the operations like cleaning, pick and place, transportation of the house-hold items from one location to another location in the place we reside. While a single robot can perform the home tasks, it might not be able to perform the tasks quickly. Time will be lost in finishing one task and then moving to another. So, it is evident that more than one robot must be used here. When more than one robot is used, controlling the robots becomes an important issue especially when the target locations and the robots are large in number. So, for easing the control of more than one robot, traits of Swarm behavior are replicated and implemented. Hence, a swarm behavior replicating group consisting of two robots are designed and fabricated that demonstrate how multiple-tasks can be handled effectively by a group of robots that perform individual actions while communicating and acting symbiotically. In the present paper, when target co-ordinates are passed to one robot, while retaining one target location, it passes another location to the other robot. Both start moving towards their target locations but continue communicating with each other. In event of failure of one of the robots, the other robot takes notice of the failure. It continues to its location, does its work at that location, and then gives a backup at the other target location by performing the task of the robot that failed.

Keywords: Swarm Robots; Home Robots; Social Robots, Domestic Robots, MaidRobots.

I. INTRODUCTION

The application of swarm principles to robots is called swarm robotics, while swarm intelligence refers to the more general set of algorithms. Inspired by colonies of insects such as ants and bees, researchers are modeling the behavior of swarms of thousands of tiny robots which together perform a useful task, such as finding something hidden, cleaning, or spying. Each robot is quite simple, but the emergent behavior of the swarm is more complex. The whole set of robots can be considered as one single distributed system, A swarm can continue even if several robots fail. This could make them attractive for space exploration missions, where failure is normally extremely costly. The swarm is expected to have many applications, including micro assembly, biological, military, medical or cleaning tasks.

II. IDEA

Domestic Robots, Maid Robots, Social Robots !!!! Technological replacement for Home Maids. But when more than one robot is used, controlling the robots becomes an important issue especially when the target locations and the robots are large in number. So, for easing the control of more than one robot, traits of Swarm behavior are replicated and implemented. When the Swarm behavior is used, all the robots, how much so in number, can be controlled via a single control center on any one arbitrary robot, nicknamed the Master. The robots at every instance keep communicating with each other. Whenever any robot fails, its nearest robots receive information about its failure and provide backup performing its operation also. Hence a home robot system with more than one robot (2 robots here) are designed implementing swarm behaviour to meet this challenge. Since home robots are autonomous or remote controlled devices capable of doing a whole lot on their own with a certain degree of artificial intelligence, autonomous character and a little degree of decision making is imparted to the robots. Research on Maid Robots that implement swarm behavior is being carried out with a fair amount of success.

II. SCOPE OF SWARM PRINCIPLES IN PRESENT PROJECT

In the present project, when target co-ordinates are passed to one robot, while retaining one target location, it passes another location to the other robot. Both start moving towards their target locations, but continue communicating with each other. In event of failure of one of the robots, the other robot takes notice of the failure. It continues to its location, does its work at that location, and then gives a backup at the other target location by performing the task of the robot that failed. Thus, a co-operative system of individual robots that interact with each other and perform tasks is created. At a bigger level, if more number of such robots is considered to perform tasks in this fashion, duplication of swarm behavior will be demonstrated. Though, since the robots do not co-operate to sweep over any area, solve problems to find optimum solutions or have any learning mechanism and do not employ any swarm algorithms as mentioned above, it would be inappropriate to call this particular project a direct application of Swarm intelligence. Hence, in this project only the Swarm behavior was studied and was adapted. The way the robots behave and perform the given tasks is an inspiration drawn from observation of Swarm behavior in social insects.

IV. LITERATURE REVIEW – GAPS IN RESEARCH

Smart Home is the next gen living place for every individual. These homes need medium sized smart Robots to acts as assistants. Literature review has been presented in theme of...
Mobile Robots, Home Robots, Swarm Robots, and Swarm-Service Robots. Mobile Robots: This first category describes about the basics of mobile robot for vacuum cleaning, painting, demining and foraging, etc. Slice decomposition technique in contrast with grid map technique has been presented. DmaxCoverage algorithm that decides the coverage path by considering the deadline for coverage, which is beneficial when the time for the coverage is not sufficient to cover the entire target area has been presented in the literature. Home Robots: As mentioned in the second category of research cleaning is the major criteria, consumers are expecting from Home Robots. Also, this literature emphasis how these Robots are useful for working women and people with physical disabilities. This category of literature mentions about the characteristics of cleaning robots, their laboratory demonstration, and technology used. The literature also shown the lack of clarity in the areas of sensor and sensor fusion for cleaning. Swarm Robots: Third category of literature discusses about the difference between swarm robotic systems from that of a mobile robot to be used as stand-alone. Kobot, is a new mobile robot platform which is designed to satisfy as much of the requirements like infrared-based short-range sensing system that can make proximity measurements with minimal interference from environmental lighting conditions as well as from other robots. This category mentions the advantage of using Zigbee technology. Particle Swarm Optimization (PSO), a bio-inspired global optimization technique where each robot was placed in pre-defined positions with a target position corresponding to a single target has been mentioned. The robots would search in spirals till the target was found by any one of the robots. Once the target was detected the robots would reach the target. This category speaks about how a complex task can be partitioned into more manageable subtasks which can be tackled by a swarm of robots in a self-organized way. These methods allows a swarm to reach a near-optimal allocation in the studied environments, can easily be transferred to a real robot setting, and is adaptive to changes in the properties of the tasks such as their duration. Modeling methods for swarm robotics has been discussed in the literature. Cooperative control mechanisms in swarm robotics for flocking, navigating and searching applications has been discussed. Robotic Darwinian Particle Swarm Optimization (RDPSO), evidencing that sociobiological inspiration is another interesting algorithm for Swarm movement. The RDPSO algorithm converges to the optimal solution faster and more accurately than the other approaches without significantly increasing the computational demand, memory and communication complexity. Swarm based task assignment capability to Takayama’s enclosure model has been presented in the literature. Swarm Service Robots: Fourth category of literature speaks about the usage of Swarm Robots in Service industry, which form the basis for this research. In this category authors discussed how Swarm Robotics tackles the very same service problem from a different stance, i.e., as the result of a team effort of simple units. How a Swarm-bot can readily cope with occasional failures of some components and promptly reshape the remaining swarm so as to replace the role of the failing units has been presented by the authors. Cleaning protocols has been presented by the authors. Autonomous self-assembly distributed swarm flying robot- DSFR, which can drive on the ground, autonomously accomplish self-assembly and then fly in the air coordinately. Concluding the review, a challenging task of developing Robots with Swarm Technology has been noticed, which is the base for this experimental work.

V. OBJECTIVE OF STUDY

The swarming behavior of ants, bees, termites, and other social insects has implications far beyond the hive. Swarm intelligence — the collective behavior of independent agents, each responding to local stimuli without supervision — can be used to understand and model phenomena as diverse as blood clotting, highway traffic patterns, gene expression, and immune responses, to name just a few. Swarm technology is proving useful in a wide range of applications including robotics and nanotechnology, molecular biology and medicine, traffic and crowd control, military tactics, and even interactive art. Robots are increasingly being used as Maid Robots. Time is always been an important part of Domestic Works. Swarm Home Robots can increase the efficiency of domestic works & saves the time. The objective of the present project is to study swarm behavior and its implementation in Domestic Robots to make them more efficient.

VI. METHODOLOGY

In the present project, when target co-ordinates are passed to one robot, while retaining one target location, it passes another location to the other robot. Both start moving towards their target locations, but continue communicating with each other. In event of failure of one of the robots, the other robot takes notice of the failure. It continues to its location, does its work at that location, and then gives a backup at the other target location by performing the task of the robot that failed. Thus, a co-operative system of individual robots that interact with each other and perform tasks is created. At a bigger level, if more number of such robots are considered to perform tasks in this fashion, duplication of swarm behavior will be demonstrated. A GSM module is used to read the two target co-ordinates sent from a mobile phone to one of the robots (arbitrarily called as the Master). The Master, retaining one location, passes on the other target location to the other robot (arbitrarily called as the Child) using the Zigbee wireless communication system. Knowing their own present locations by virtue of their on-board GPS systems and having the target locations, the robots compare the two and traverse towards the target location. They keep communicating using the Zigbee Wireless communication system.

A. Circuitry

Figure 7.6 and 7.7 represent circuitry of the robot 1 (Master) and 2 (Child/Slave) respectively. In the first robot there are GPS, GSM, ZIGBEE, where GPS is used to know the present coordinates of the robot from satellite. GSM is for sending the target co-ordinates directly to robot1 and indirectly to robot 2. ZIGBEE is for sending the target coordinates to the robot 2. Other than these components MICROCONTROLLER is for programming the robots navigation according to the present and target coordinates. Drivers are for controlling motor rotation for navigation and also for switching the serial communication from GSM to GPS and vice versa. MAX232 is for converting TTL logic levels to cmos and vice versa. Actually GPS GSM ZIGBEE all these are in TTL logic where our microconroller is CMOS logic, so in order to make the communication possible MAX232 is used as an interface. In the robot 2 ZIGBEE is used to receive the coordinates from and also for the communication between the two robots. Similarly robot 2 contains a GPS to know the present coordinates and work to reach the target. There is no GSM in robot 2 as it is controlled by the robot 1. At the end after reaching the target both the robots perform the respectivetsaks
Both the robots will have associative circuitry as shown in circuit diagram Figure 7.8. It is the basic working system in the robots which takes feedback from all the components and controls the motors accordingly through relays. The relays are programmed in such a manner that when both the relays are simultaneously on or off it makes the robot to stop. Similarly the present coordinates of the robot and the target coordinates are displayed in the LCD display. The display is interfaced to the port 3 in the MICROCONTROLLER at pin 10. The GPS continuously tracks the satellite signal and feeds it to the microcontroller. Similarly the coordinates from human user will also reach the GSM on the Robot 1 pin 11. Then microcontroller in the Robot 1 will take the first coordinate and passes on the other coordinate to Robot 2 through XBee and the XBee on Robot 2 receives the coordinates which are fed to the controller on it. If in the meanwhile any signal link fails then robot 2 confirms that robot 1 was destroyed and performs the task of robot 1 also.

A. Algorithm for MasterRobot
1) GPS ON /* The GPS for master robot is ON*/
2) GPS READ /* Read the present locations of Master Robot from the GPS*/
3) ARRAY FILL a1 /* Collect the present location coordinates from the GPS and store it in an array a1*/
4) GSM ON /* The GSM is ON*/
5) GSM SEND /* Send both the target location coordinates via message*/
6) GSM READ /* The 1st target location coordinates are read */
7) ARRAY FILL a2 /* Collect the target location coordinates from the GPS and it in an array a2*/
8) COMPARE a1 & a2 /* Comparing the present and target locations*/
9) MOTOR CONTROLS /* Left, Right, Front, Back operations performed by the motors based on the comparison of the locations*/
10) END /* End of the program*/

B. Algorithm for ChildRobot
1) GPS ON /* The GPS for Child robot is ON*/
2) GPS READ /* Read the present location of child robot from the GPS*/
3) ARRAY FILL a3 /* Collect the present location coordinates of the child robot from the GPS and store it in an array a3*/
4) GSM ON /* The GSM is ON*/
5) GSM SEND /* Send both the target location coordinates via message*/
6) ZIGBEE READ /* Read the target coordinates from the Master robot to the child robot through Zigbee*/
7) ARRAY FILL a4 /* Collect the 2nd target location coordinates from the Zigbee and it in an array a4*/
8) COMPARE a3 & a4 /* Comparing the present and target locations*/
9) MOTOR CONTROLS /* Left, Right, Front, Back operations performed by the motors based on the comparison of the locations*/
10) END /* End of the program*/

VI. REFERENCE


