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TASK CO-ORDINATION AND CONTROL BETWEEN SWARM OF ROBOTS FOR ASSISTING FARMERS

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ABSTRACT—Swarm robotics is a new approach for the coordination of multi-robot systemsthat consist of large number of simple physical robots. This approach emerged on the field of artificial swarm intelligence. Swarm intelligence focuses on collective behaviour exhibited by natural grouping systems such as ant, bees, birds, fishes,etc. Robots are mainly being used in Agricultural area, for various applications such as sowing seeds, harvesting, and storing grains in the warehouse. Swarm robotics have been emerged as a technology to reduce the work load of farmers and thereby helping them to increase their productively multifold.

KEYWORDS—Advantage of swarm robotics,Intelligence of swarm robotics, Characteristics of swarm robotics .

I. INTRODUCTION

The term swarm robot means “Group of Robots”. Swarm robot consist of master and slave robots. In swarm robot there will be more than one master . By using this concept we can extend the coverage area either by using Zigbee module or RF module. If all the slave robots are going to perform a same task means at that time we should use RF module. If all the slave robots are going to perform a different task means at that time we should use Zigbee module.The main objective of this paper is to establish a communication among group of robots using Zigbee and to perform a task allocated to each slave roobts. Once the task is completed by slave robot, the slave robot will send the status of the task to sub-master robot and then the sub-master robot will transmit the status to master robot through zigbee module. The characteristics of swarm robotics are local sensing, communication capability, parallelism in task execution, robustness,scalability, flexibility and decentralized control.

1)Multi-Robot – Multi-robot systems (MRS) has *centralizedcontrol.*(ie.There will be only one master).
2)Swarmrobot –Swarm robots has *decentralizedcontrol* .In the swarm robot system there will be more than one master. The main advantage of swarm robots over multi-robot system is scalability (ie.The coverage area can be extended as per our need.)

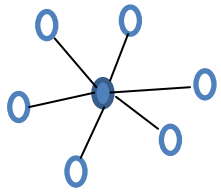


Figure:1 Multi-robot:*Centralized* control

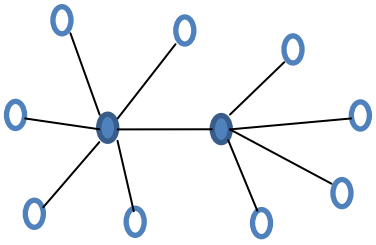


Figure:2 Swarm robot:*Decentralized* control

II. INTELLIGENCE OF SWARM ROBOTICS

Swarm intelligence focuses on collective behaviour exhibited by natural grouping systems such as ant, bees, birds, fish, etc. The intelligence of swarm robotics are classified into different algorithms. The various algorithms are Bees algorithm, particle swarm optimization, Ant colony optimization, Firefly algorithm etc. We have planned to use particle swarm optimization for our project . The concept of particle swarm optimization is to follow the leader as per the command given by master to slaves. We can find this particle swarm optimization behaviour in birds.

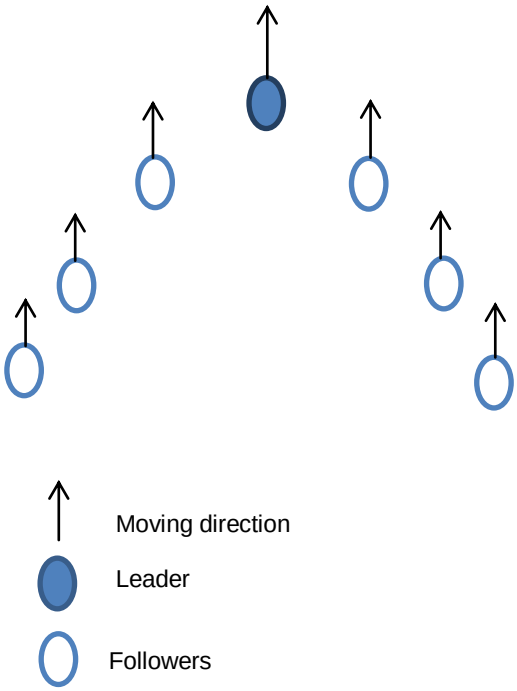


Figure:3 Flocks of birds

The above figure contains one leader bird and the rest are follower birds. The follower bird will follow the leader as per the command given by leader. This is the concept we have used in our project (ie. The slave robot will perform the task assigned to it after getting the command from master robot through zigbee, once the task is completed the slave robot will send the status of the task to master robot.)

III. CHARACTERISTICS OF SWARM ROBOTICS

The main characteristics of swarm robotics are robustness, parallelism, scalability, flexible, cheap and energy efficient. 1) *Robustness*- means no single point of failure. If one robot fails, the entire system will not get stopped. 2) *Parallelism*- means the entire task will be divided into many sub-tasks. 3) *scalability*- means the coverage area can be extended as per our need. 4) *Flexible*- means complex problems can be solved easily. If one robot fails, the work will not get stopped but their performance may degrade. 5) *Cheap* and *energyefficient*- swarm robots are simple and cheaper than single robot. Swarm robots are energy efficient because the life time of swarm is larger.

IV. BLOCK DIAGRAM

The block diagram consist of N master robots and N slave robots. Each and every master robot communicate with each slave robot. Then each slave robot perform the task assigned to them which is being instructed from the master robot. Finally the slave robots will give the status of the task to master robot.

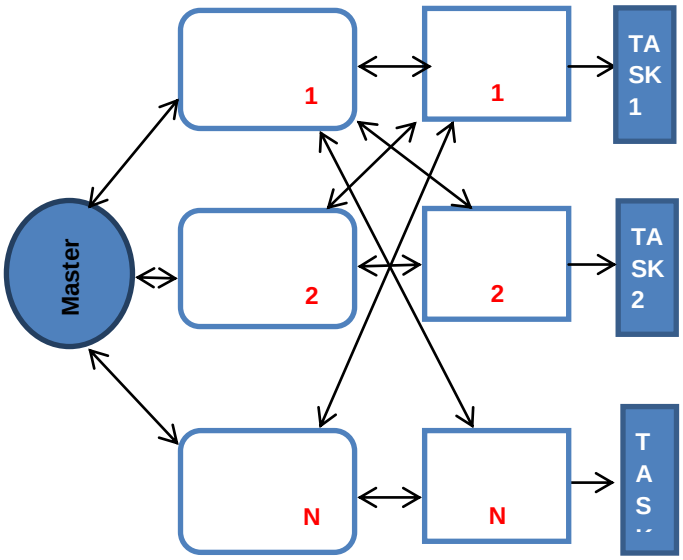


Figure 4: Swarm of robots

In the above figure between the master and slave robots we have used bidirectional arrow , this indicates that master and slave robot can be able to send and receive information through zigbee.
Task 1:Sowing seed
Task 2:Harvesting
Task 3:Sensing moisture content of soil
Task N:Watering the plants

The swarm robot architecture consists of master robots and few slave robots.

1) Master Robot: In the master robot we have planned to use Arduino uno, push buttons, LCD and Zigbee.
2) Slave Robots: In the slave robot we have planned to use Arduino uno, LCD and Zigbee.

V. MASTER-SLAVE COMMUNICATION

To establish a communication among swarm of robots we have used zigbee module. With the help of zigbee module each slave robot can perform different task assigned to them after getting command from sub-master robot , this sub-

masterrobot will get the instruction from the master robot which is located at farmer side through zigbee. Once the sub-master robot got the command from master robot, it will just transmit that command to corresponding slave robot. Once the task is completed by slave robot it will send the status of the task to sub-master robot and the sub-master robot transmit that status to master robot . Zigbee communication among the master, sub-master, and the slave robots is possible only if the PAN ID (Personal Area Network Identification) is same for the master and the slave robots. Each slave robots has their own network address. Eg: If the destination address in the master robot matches the network address of slave-3 robot, this indicates that there is a successful communication between the master robot and the slave-3 robot. The figure shown below consists of two master robots, this indicates that there is no single point of failure. If one of the master robot fails means we can communicate through other master robot. Once the communication between master and slave robot is proper, then each slave robot will perform their task assigned to them. Once the task is completed by slave robot , it will send the status of the task to sub-master robot and the sub-master will send the status to master robot which is located at farmer side.

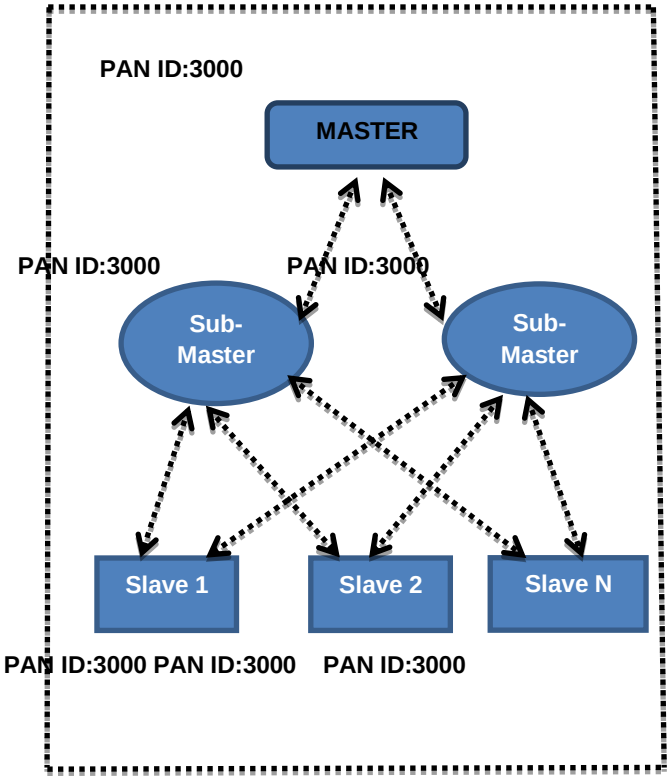
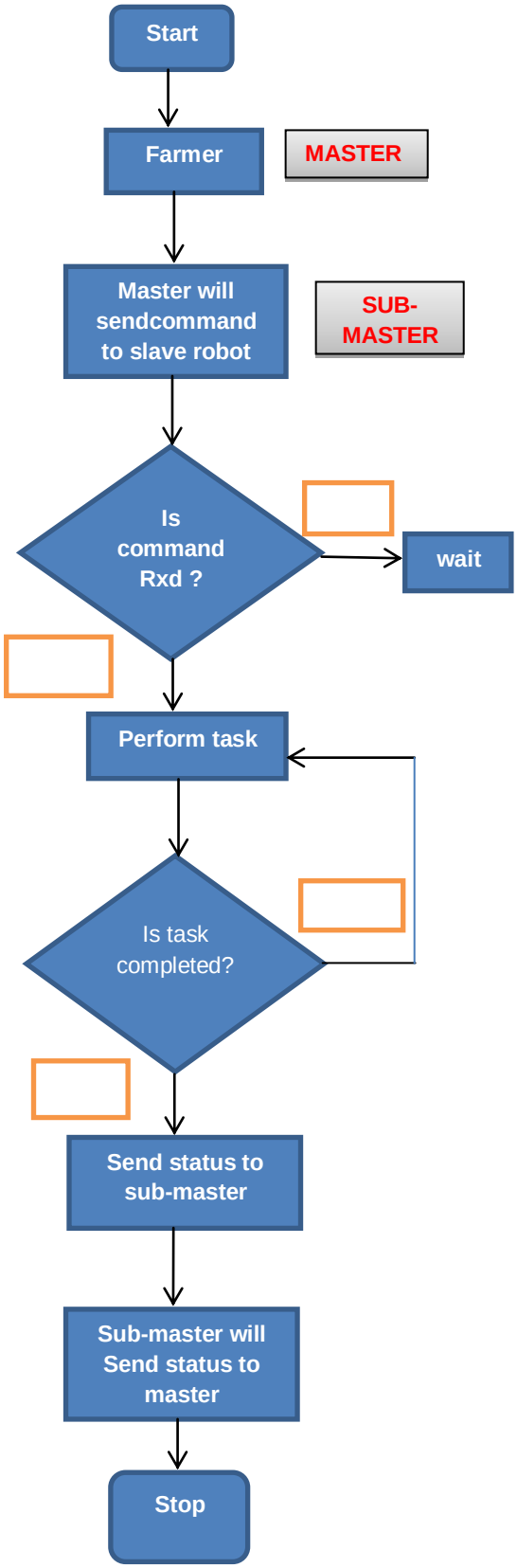
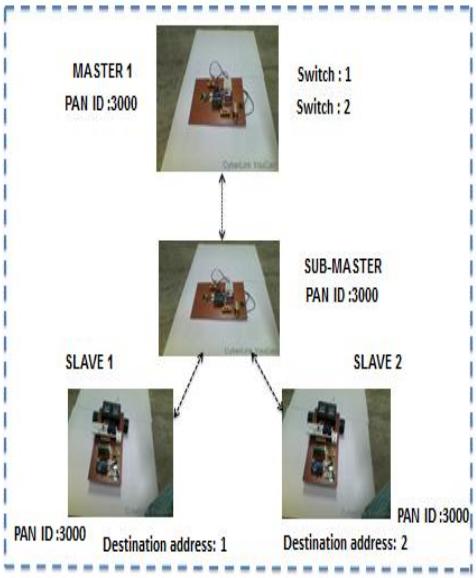


Figure:5 Master-slave communication

VI. FLOW CHART

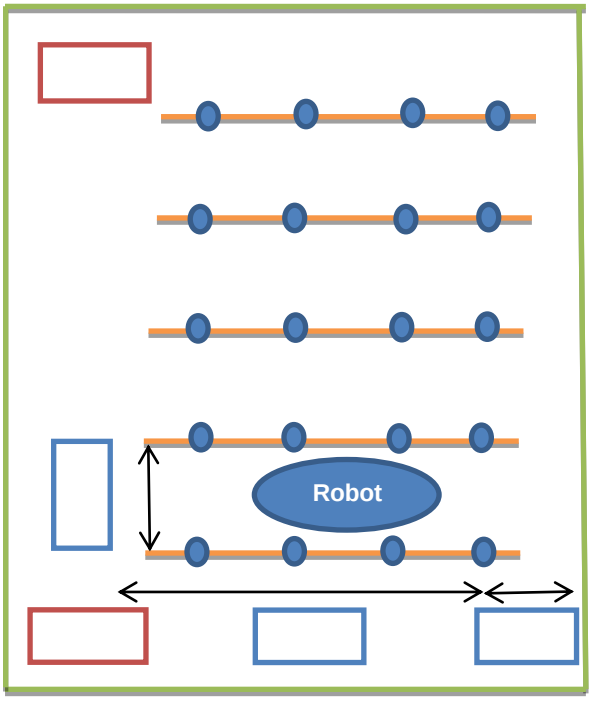


VII. PROPOSED WORK



VIII. SAMPLE FIELD

Necessary conditions:1) consider a field having a rows of equal length.2) The distance between each row should be equally spaced. 3) place a metal, where we want to put a seed/water the plants/sense the moisture content of soil,etc.



Metal

We have planned to use this swarm architecture for Agricultural purpose. If farmer decides to sow the seed/sense the moisture content of soil/watering the plants,he just want to press the push button in the master robot. For example if the farmer has pressed the first push button in master robot,then the command will be send to slave robot 1 through zigbee. Once the slave robot got the command it will perform the task assigned to it. The following is the working mechanism of slave robot.(For example: consider the slae robot 1)

Slave robot 1: Slave robot 1 will perform the task 1(ie.sowing seeds) after getting the instruction from the master. To sow the seed the robot will sense for metal by using inductive proximity sensor, if metal is detected the robot will stop there and the motor connected to the seed sowing setup will run and put the seed.once the task is completed the slave robot will send the status (ie.task completed) of the task to master robot.

IX. CONCLUSION

This paper highlights the application of swarm robotics in agricultural field. Thus the swarm robotics concept will be more useful for the farmers to increase their yield rate and completely reduce the number of labours required. We believe this topic is of great potential.

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