

SWARM INTELLIGENCE

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ABSTRACT

Robots are devices which can perform a given task more efficiently and tirelessly than that of a human. Robots are used in places where human cannot intervene. Swarm is biological behavior observed in animals like ants, bees, bats etc. through which they communicate among themselves. Swarm Robotics is an advancement in the field of robotics in which multiple robots coordinate with each other to perform task collectively. In this paper we are going to demonstrate swarm robotics using 3 robots which will communicate using RF (2.4GHz). For proper coordination of robots we are using ant colony algorithm. This Project displays robots performing a fire extinguishing task without human intervention by using their artificial intelligence. The project involves three stages namely Detection of fire, calculating the shortest path and extinguishing the fire. We are describing the algorithm with obstacles.

Key Words: *Ant colony algorithm, Fire detection, Multiple robots, RF communication, Swarm behavior.*

INTRODUCTION:

Traditionally in area caught by fire, the fire guard enter the area to extinguish the fire risking their own lives. Whenever a guard detects fire, he communicates to the other guards and direct them to the fire spot using walkie-talkies. But they cannot communicate the exact path to their colleagues.

The system is developed here is the replication of this process, with the advantage of communicating the exact path of fire spot. In this System there will be three robots (master and two slaves) which will communicate using RF. Master will take over and instruct slave robots about the path and other activities. Hence using this system we can save precious lives. This system can also be used in hazardous places where humans cannot intervene. The main purpose of our project is to demonstrate robotics with artificial intelligence. The complexity of the project can be increased by using more number of algorithms and "n" number of robots.

The system consists of three stages.

A. Searching: The search algorithm chosen is ant food searching algorithm. As we know that ant are blind. They go in search of food on a random path. And they also keep on dropping pheromone on their path so that other ants follow the same path and reach the food.

B. Path Selection: The path sent by the two slaves on detection is sent to the master is selected by comparing their length. Then the master selects the shortest path and reaches the destination. We know that ant drop pheromone. But we cannot do this as it becomes really complicated in case the traces overlap each other, as our path is not prescribed it is a random path. The robots keep on saving the path in the microcontroller memory and uses the same to send it.

C. Task completion: On reaching the destination the task of our robots is to extinguish the fire in the place. The robots are provided with fire extinguishers module to extinguish the fire and to make the spot clear. After completion of above stages our demonstration is completed.

1. Overview of system:

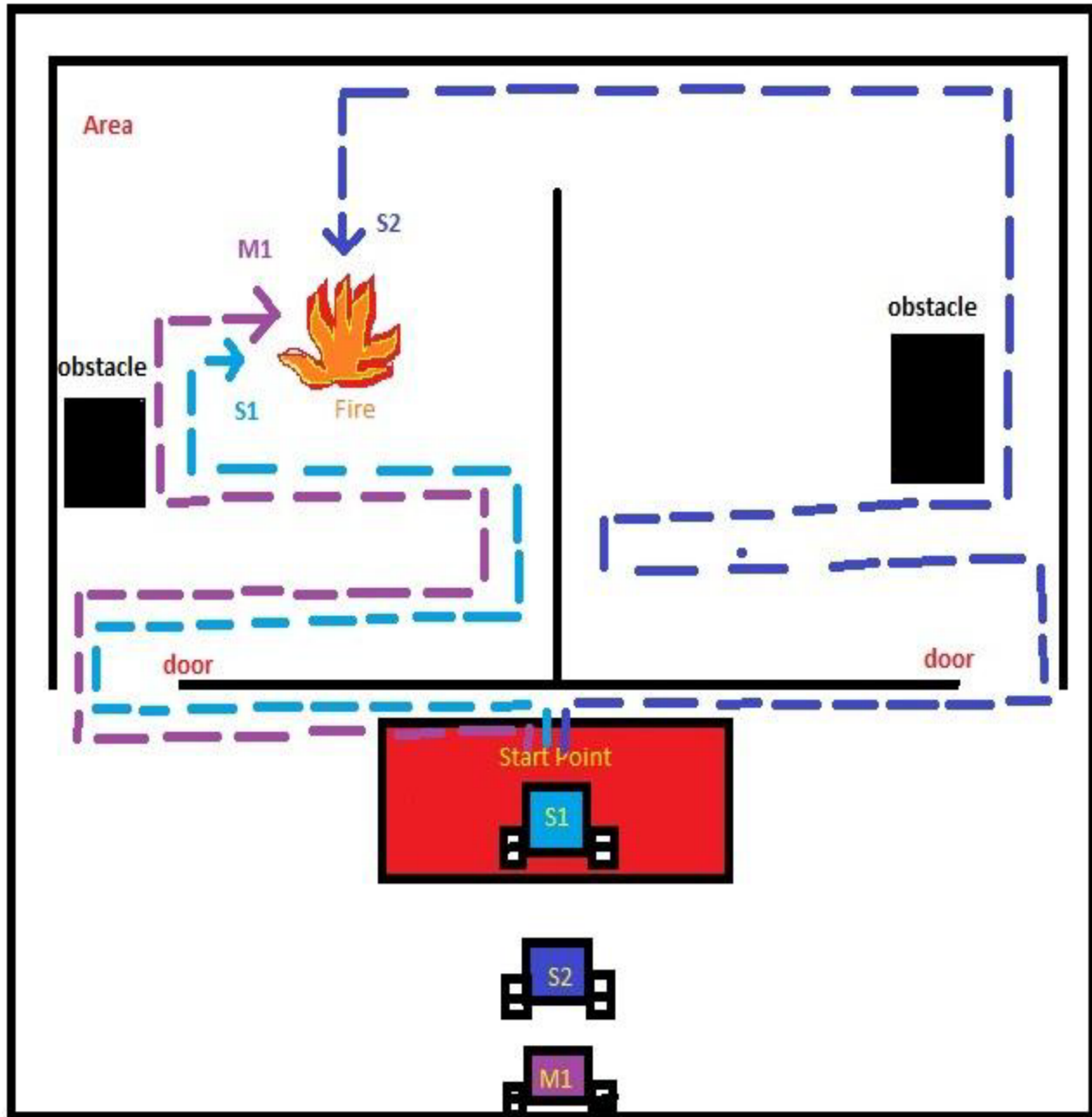


Figure 1: - S1: Slave1, S2: Slave2, M1: Master. {1} Slave1 enters Area in search of fire. {2} Slave 2 enters Area in search of fire. {3} Master Calculates both path and selects shortest path and reach the destination. {4} finally complete the task (fire extinguishing).

Firstly Slave1 enters the Area for search of fire spot. Each robot starts its path from the start position shown in above figure. As Slave 1 leaves after an interval of 3 seconds Slave2 enters start point and goes for searching in other direction. While searching the fire spot the path keeps on recording in the microcontroller memory. The path can be recorded on time basis the motor moves.

After detection of fire the whole path recorded in memory is sent to master robot and to cross check an

acknowledgement message can transmitted from master to the slave. On receiving the path from both the slaves, the master decides the path to select by comparing them and calculating the shortest path.

After selecting the correct path the master robot reaches the fire spot and helps the other two robots to extinguish the fire. And so the following task is completed. This demonstrates the swarm behavior.

2. ALGORITHM:

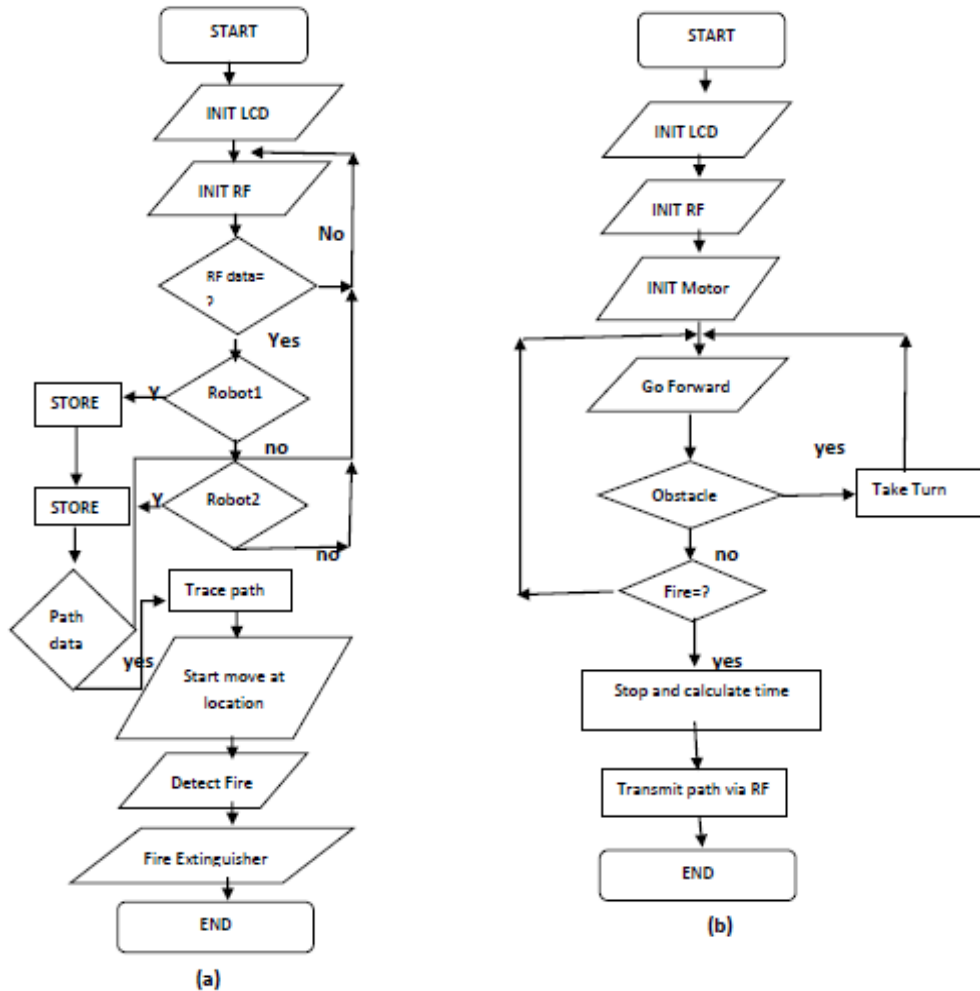


Figure. 2: - (a) Master robot, (b) Slave robots

3. SYSTEM DESCRIPTION:

Our project consist of different modules such simple two wheeled, fire extinguisher model, fire sensor, LCD display (16X2), 12V DC motors, Atmega16,Infrared obstacle sensor.

The block diagram of the system is given below.

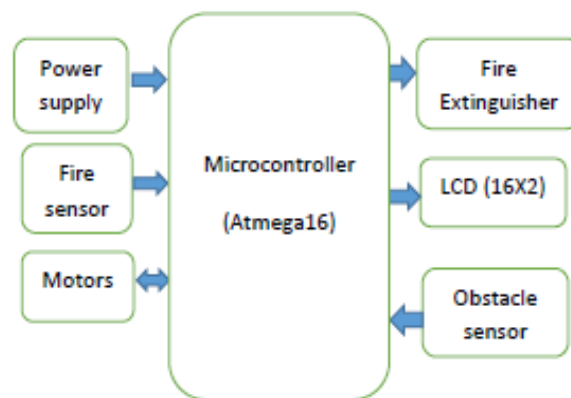


Figure. 3: Block diagram of Robots.

a) Liquid Crystal Display (16X2):

We have used LCD in our project to visualize the output of the application. We have used 16x2 LCD which indicates 16 columns and 2 rows. So, we can write 16 characters in each line. So, total 32 characters we can display on 16x2 LCD.

LCD can also be used in the project to check the output of different modules interfaced with the microcontroller. Thus LCD plays a vital role in a project to see the output and to debug the system module wise in case of system failure in order to rectify the problem.

b) Fire Sensor:

The fire sensor we have used is an infrared based sensor. Which detects infrared light emitted from the fire and give signal to the microcontroller. This sensor gives better response than the smoke sensors.

c) Obstacle Sensor:

It is a basic obstacle sensor made with infrared LED, photodiode and OPAMP. It is just used to avoid the obstacles in the robots path.

d) Fire extinguisher model:

It is fire extinguisher easily available in the market which can be assembled with mechanical assembly which should be activated by a relay.

4. PRO'S AND CON'S**a) PRO'S**

- Efficient way for surveillance.
- Works without human interference.
- Robust system using artificial Intelligence.
- A. Work in environments where humans cannot work.

b) CON'S

- Cannot handle dynamic obstacles.
- Algorithm can be made smarter.

5. CONCLUSION

In this Project we have studied Swarm Intelligence. Many algorithms related to swarm intelligence are being worked on implementation in this project. Our project shows that for the task of communication, we make our project better by using the collective efficiency that ant colonies achieve, while relying on hardware implementations that are feasible in simple and small robots.

By including more algorithms we can make the system smarter and more efficient. The robots can also be programmed with multiple algorithms and choose the best algorithm for the given task. The number of robots in this project can be increased to increase efficiency.

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