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Collaborative Work Management Using SWARM Robotics

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ABSTRACT:
Swarm robotic systems which are inspired from social way of acting of wildlife specially insects are becoming a interesting topic for multi-robot researchers. Simulation software is mostly used for research in swarm robotics due the hardware complexities and cost of robot platforms. However, simulation of large numbers of these swarm robots is ultimate complex and often inaccurate. We present the design of a low-cost, autonomous micro robots for swarm robotic applications. Micro robots Uses a circular platform with a diameter of 4 cm. The robot has been tested in individual and swarm scenarios and the observed results demonstrate its achievability to be used as a micro sized mobile robot as well as a low-cost platform for robot swarm applications [1].

Keywords : swarm robotics, autonomous micro robots robotic application

I. INTRODUCTION

Swarm Robot is an fascinating concept to provide a robust robotics system by utilizing large numbers of identical robots. Swarm algorithms are mostly inspired from social way of acting of insects and other wildlife. This concept allows coordination of simple physical robots to mutually perform tasks. Simulation of the sheer mass number of these robots is extremely complicate and results do not often meet the observed results of what would be exhibited in real robot experiments. Autonomous and decentralized control of the swarm systems are achieved by providing well defined interaction rules for individual robots.

These rules are executed continuously in an infinite loop which could provide suitable collective way of acting in robotic environments. Biological self-organized behaviors provide some of the best examples to perform by robots swarms . Therefore, the platform must be able to follow swarm behaviors found in nature. It should be designed with small physical dimension to allow large scale swarm behavior study in a lab area. A practical mechatronics design is required to simplify replication and ensure platform homogeneity as the standard definition of swarm robotics
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II. Related Work

The designed hardware and control mechanism of Micro robots with regard to the individual and social behaviors are explained in this section. Fig. 1 shows a Micro robots robot and its different modules.

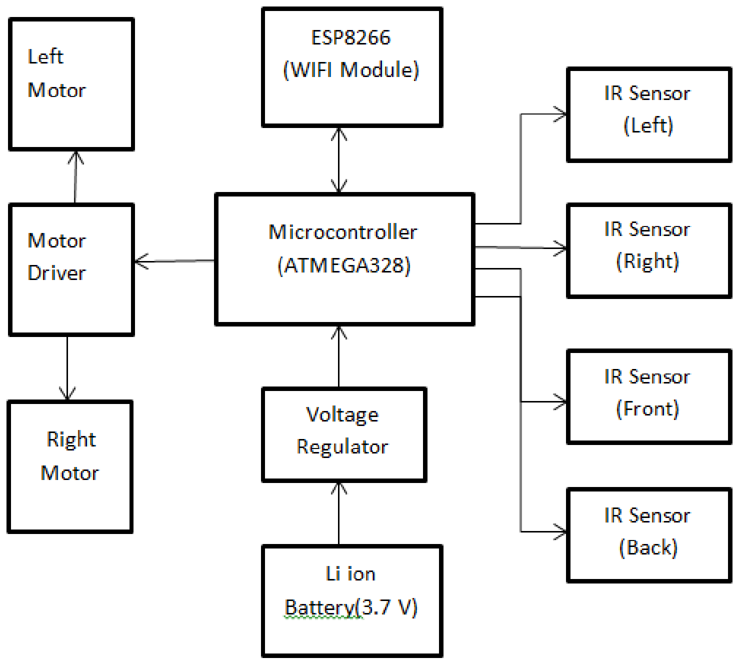

Fig 1.Block Diagram Of Micro Robot

1. Sensory System

The basic configuration of the Micro robots uses only IR proximity sensors to avoid obstacles as well as the collision with the other robots, and a light sensor to read the luminance of the ambient light. The IR sensory system consists of two different types of IR module, namely, short range (bump sensors) and long-range (proximity sensors). A combination of three short-range sensors and an independent processor gives us an ability to have an individual process on obstacle detection which works in parallel with the rest of the system. The long-range communication is composed of six IR proximity sensors (each 60◦ on the robot's upper board) for obstacle and robot detection. The IR sensing system is able to distinguish robots from obstacles. Obstacle detection and distance estimation use fundamental principles of electromagnetic radiation and its reflections. The reflected IR value that is measured by a sensor is mathematically modeled by the following equation :

$$s(x,\theta) \models \frac{\alpha_c \cos\theta}{x^2} + \beta_c$$

where $s(x, \theta)$ is the output value of sensor, x is the distance of obstacle, and θ is the angle of incidence with surface. The model variable αc includes several parameters such as reflectivity coefficient, output power of emitted IR, and sensitivity of sensor. βc is the offset value of the amplifier and ambient light effect. The model parameters (αc and βc) are estimated empirically and apply on future calculations.

In addition, a light sensor is directly connected to the both processors – $\mu 1$ and $\mu 2$. Therefore, each controller is enabled to translate the illuminate of the ambient light from an analogue value to a digital number between 0 and 255. In robot swarm scenarios, light is mostly used as a cue in the group level task such as aggregation of honeybees

2. Inter-robot Communication

In multi-robot experiments, robots need to have a communication media to share their information and make a collective decision. Wireless communication is mostly used when a scenario is accomplished with mobile robots. Benefits of using IR in swarm applications include position estimation, neighboring robots recognition, direct communication and can be utilized for obstacle avoidance.

Micro robots translates its IR receivers' values to estimate the distance and bearing of the neighboring robot. The distance of a neighbor can be simply judged by the amplitude of the received IR. Since the robots' receivers are placed symmetrically apart (60◦), we can estimate the relative angular position of the neighboring robot using the following equation:

$$\phi = \operatorname{atan}\left(\frac{\sum_{i=1}^{6} \hat{s}_i \sin(\beta_i)}{\sum_{i=1}^{6} \hat{s}_i \cos(\beta_i)}\right)$$

where φ is the estimated angular position of the neighbor, βi is the angular distance between *I'*th sensor and the robot's head. ˆ *si, i* ∈{1, 2, 3, 4, 5, 6} is the translated IR intensity from sensor *i*.

3.Power Management

Swarm robot scenarios, the robot must have a enough battery power to complete a given task. To achieve a long-term autonomy, we need to have a proper power management system to monitor all the functions of the robot during a task and control the battery charging current during a recharging process that increases the battery life. In Micro robots, the lower board is responsible for managing the power consumption as well as recharging process. Power consumption of the robot with normal motion (in a quiet arena with only walls) and short-range communication (low-power IR emitter) is about 560 mA.
However, it can be reduced to about 200 mA when the emitters are turned on occasionally and the robot moves with faster speed. A 3.7 V, 600 mAh (extendable up to 1200 mAh) lithium-polymer battery is used as the main power
source, which gives an autonomy of about 3 hours for the robot. Higher amount of battery consumption is used by I Remitters and decoders when the emitter is continuously turned on. Therefore, the power consumption can be reduced at least to 50% using pulse modulation in IR emitters as well as short data packet size.

III. Implementation

After recognizing drawback of SWARM Robotics it become challenge to improve efficiency and the communication between the bot and server. Here continues communications required between them. Which is not presented previous version. In this system bots continues send request to server for the communication because server never request to client.

Following fig (2) shows step of working of this system.

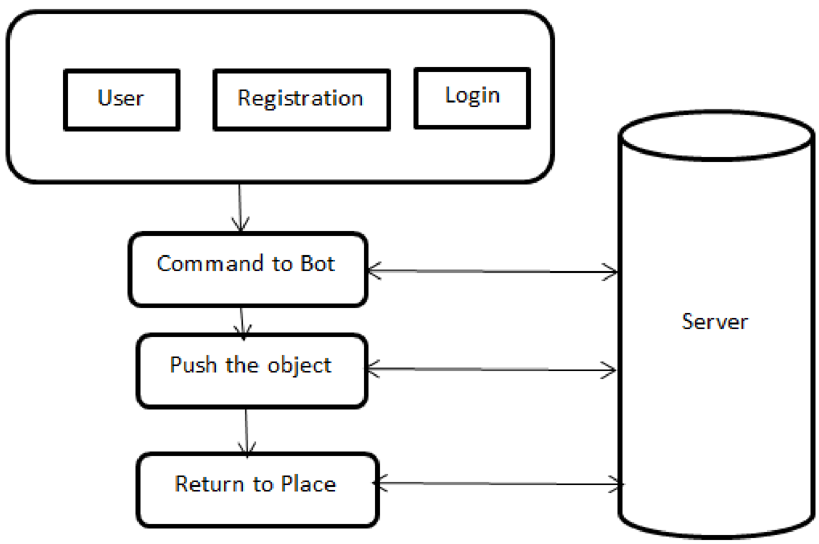

Fig 2 Block diagram of Implementation

Algorithm:
STEP 1: User login to the server
STEP 2: Get command form server
STEP 3: BOT do the assign work
STEP 4: Task completed
STEP 5: Return to base.

IV. Conclusion

We presented design of a new low-cost and open-platform micro robot to be used in swarm robotic researches. Experiments were performed on hardware components such as communication and sensory systems. Self-organized cooperation strategies were applied to control and coordinate the swarm of Robots.

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