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OMICRON: DESIGN OF SWARM ROBOT WITH WIRELESS COMMUNICATION

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ABSTRACT

This work focuses on the issue of designing, constructing, and programming an individual robot within a robotic swarm. It also provides a brief overview of the swarm robotics and development of robotics, its methods, and characteristics. The mutual interaction between humans and robots is based on communication between them. This approach is applied in swarm robotics, not only between humans and machines but also among machines themselves. This paper will offer an overview about the relations between concepts, knowledge, and principles of swarm robotics

I. INTRODUCTION

Today, in robot construction, emphasis is placed on functionality rather than appearance. Robots are intelligent devices that accompany people in their everyday lives. Often, it is more advantageous for robots to work and act in groups because they can jointly perform even more demanding tasks. The next trend in robotics development is the utilization of a group of mutually cooperating individuals, known as a swarm of robots. This involves assembling multiple robots into a collaborative group, where they exchange information [1]. Further, the research of swarm robots can be observed in two directions – development of functionally independent swarms from other operational elements as e.g. human operators or development of human- centric swarms being able to directly collaborate with humans [2], which represents a certain extension of the first direction and puts some additional requirements on the communication and operational capabilities of such robots. The main goal of this work is to design a cheap robot that can be a part of swarm robotics based on local communication achieved through wireless transmission, such as Bluetooth, WiFi, or other wireless methods. This robot, named OMICRON, can be easily and inexpensively assembled, even in amateur conditions. In this work, we will consider various practical applications of robot swarms, inspired by behaviour of some animal communities. We will deal mainly with robots that belong to the swarm robotics, addressing fundamental questions about the characteristics of the terms 'swarm' and the utilization of swarm robotics technology [3].

II. EXISTING SYSTEM

Today, in robot construction, emphasis is placed on functionality rather than appearance. Robots are intelligent devices that accompany people in their everyday lives. Often, it is more

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advantageous for robots to work and act in groups because they can jointly perform even more demanding tasks. The next trend in robotics development is the utilization of a group of mutually cooperating individuals, known as a swarm of robots. This involves assembling multiple robots into a collaborative group, where they exchange information [1]. Further, the research of swarm robots can be observed in two directions – development of functionally independent swarms from other operational elements as e.g. human operators or development of human-centric swarms being able to directly collaborate with humans [2], which represents a certain extension of the first direction and puts some additional requirements on the communication and operational capabilities of such robots

III. PROPOSED SYSTEM

The main goal of this work is to design a cheap robot that can be a part of swarm robotics based on local communication achieved through wireless transmission, such as Bluetooth, WiFi, or other wireless methods. This robot, named OMICRON, can be easily and inexpensively assembled, even in amateur conditions. In this work, we will consider various practical applications of robot swarms, inspired by behaviour of some animal communities. We will deal mainly with robots that belong to the swarm robotics, addressing fundamental questions about the characteristics of the terms 'swarm' and the utilization of swarm robotics technology

IV. LITERATURE SURVEY

I. Olaronke, I. Rhoda, I. Gambo, O. Oluwaseun, and O. Janet, "A systematic review of swarm robots," Current Journal of Applied Science and Technology, pp. 79–97, 2020.

Advances in robotics have paved the way for a novel approach of organizing large numbers of robots, otherwise referred to as multi-robots. Multi-robots can either be homogenous or heterogeneous. Nevertheless, a group of autonomous and relatively homogenous robots that interacts with one another as well as with their environment is referred to as swarm robots. Swarm robots are biologically inspired by natural swarms as found in animal societies such as birds and fishes as well as social insects such as honey bees, wasps, termites and ants. Hence, they exhibit certain properties which are similar to those found in these creatures such as aggregation, selforganization, foraging as well as flocking. Swarm robots work together to achieve a desired goal, which is usually too complex for a single robot to accomplish. They are typically characterized by simplicity of individuals, fault tolerance, autonomy, parallelism, high reliability, scalability as well as robustness. They can be used for mining, military, medical and agricultural activities. They can also be used for search and rescue missions, toxic waste cleanup, and for piling sandbags along coastlines in preparation for floods or hurricane. Nevertheless, swarm robots are plagued with the stigma of widespread, interference, uncertainty, safety and lack of reliable communication. Furthermore, studies in swarm robotics are practically limited to virtual reality simulations. Hence, the principles of swarm robotics are rarely applied to real-life problems. It is against this background that this study systematically explores swarm robots. This study reviewed eighty literatures relating to swarm robots. These literatures were obtained from journal articles, technical reports, books, and conference proceedings. The selection of these literatures was based on their relevance to the research problem. This study revealed that the application of swarm robots to real life problems would promote the development of systems that are robust, fault tolerant and scalable. Several creatures move in groups or swarms of few to more than millions of individuals. Swarming is mainly applied to animals and social insects such as honey bees, wasps, locusts, termites and ants. Typical examples of animals that exhibit swarming behaviour include fishes, turtles and birds. Interestingly, swarming is referred to as flocking or murmuration in birds, herding in tetrapods such as turtles and shoaling or schooling in fishes. Characteristically, these creatures are usually of the same size, and they move together in search of food and shelter because discrete individuals have a higher chance of surviving in the group than when alone. They support and protect themselves effectively in the swarm. They respond to the speed of their counterparts and avoid collisions within the swarm [1]. Also, they communicate with one another while maintaining a decentralized network and exhibiting selforganized behaviour [2,3]. Besides, animals and insects are not considered overloaded even as more individuals join the swarm. These creatures also exhibit stigmergic communication. For instance, ants lay pheromone on the ground. At the same time, wasps use secretions to signify the presence of danger to their mates and indicate the paths to their food sources. The goal of insects and animals in swarms is to ensure that the process of solving problems is more efficient through cooperation and division of labour. Fig. 1 shows examples of diverse creatures in swarms. The interactions exhibited by the animals and social insects in swarms have been a source of inspiration to many kinds of research in swarm intelligence [8,9]. Hence, Tan and Zheng [10] emphasized that swarm intelligence is a soft bionic of natural swarm. The term swarm intelligence is a concept proposed by Gerardo Beni in the 1980s [11]. It is a branch of computational intelligence that is composed of a population of simple agents interacting locally with the environment and one another [12]. Tan and Zheng [10] define swarm intelligence as a system that consists of a group of individuals autonomously controlled by a clear set of rules and local interactions. Bonabeau et al. [13] view swarm intelligence as any attempt to design algorithms or distributed problem-solving devices that are inspired by the collective behaviour of social insects and other animal societies. From the definitions above, we deduced that swarm intelligence is a branch of computational intelligence that is composed of a population of relatively simple, homogenous and autonomous agents that communicate locally with one another and their environment while adhering to simple behavioural rules.

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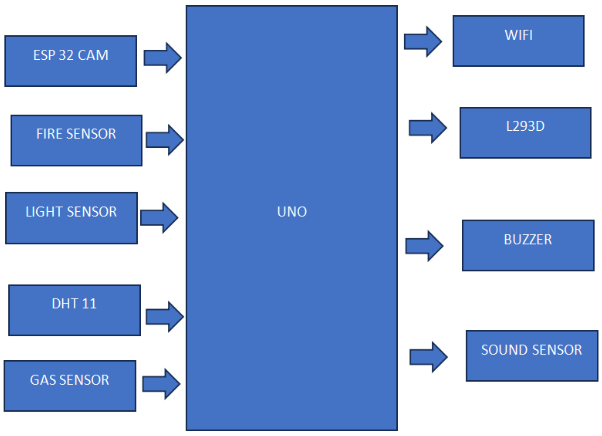
Block diagram



IV. CONCLUSION

In the course of analyzing experiments in real and simulated environments, we have confirmed the effectiveness of the OMICRON robot model and its mobility capabilities. This model is suitable for the membership in the robotic family because it meets the basic characteristics of such a member. The model is designed to be simple and can be constructed even under amateur conditions. We validated the designed model by both simulation and practical experimentation. Through these experiments, we tested its overall functionality. Based on the obtained results, we can conclude that the designed robot OMICRON is fully functional. It can perform basic movements at different speeds and can autonomously avoid obstacles in its environment based on the sensory data. This model offers various modifications and perspectives for future use, including the addition of components such as cameras, other actuators, or distance, color, sound sensors, and object manipulation capabilities, as well. The potential applications of the robot OMICRON are promising for a broad area of use. Experiments have shown that when the robot is in motion, there are deviations influenced by various factors such as the environment, surface, air resistance, and battery capacity. Precise results are achieved with simple linear movements, but with longer movements, deviations increase exponentially. Cumulative deviations appear during complex kinematic movements. These deviations can be minimized in various ways, such as adjusting its centre of gravity, adding a gyroscopic sensor, improving motor calibration, and implementing software enhancements. The prospects for using this robot include expanding its hardware features, such as adding a camera, illuminating with different colors based on its activities, and incorporating additional sensors to gather information about its surrounding environment.

VI.REFERENCES

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