Autonomous Swarm Robots for Industrial and Disaster Mitigation Application Communication and Swarm Intelligence.

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Abstract: *Contemporarily in analysis swarm artificial intelligence is associate degree flowering division underneath artificial intelligence. The nomenclature swarm intelligence is sparked from, nature swarm where swarm means a group. It consists of a master bot controlling multiple slave bots. In this paper, a brief idea about the branch of swarm robotics and their application in industrial and disaster management has been brought out. It is based on swarm intelligence and wireless communication, bearing coordination, synchronization and obstacle avoidance*

I. Introduction

With the implementation of swarm intelligence, which comprises of a single master robot and multiple slave robots; the challenges faced for accomplishing a task using the single traditional robot can be vanquished. These traditional robots are sensitive, as, even if the smallest part of the robot gets affected it results in hindering the performance of the entire system. Unlike the conventional singular robotic system, the swarm robotic system's activity or performance is not hampered as a result of any undesirable failures of an individual slave bot. Also using this swarm automation technique, the previously required manpower reduces to a great extent. Swarm robotics is very effective as every representative in the swarm is uncomplicated having smaller battery size and an extended life span as compared to the regular robot. Therefore, making it energy efficient and cost efficient. As nature swarm implies working in a team, it also provides time efficiency. Further, the basic idea behind swarm robotics is that it consists of a master bot and numerous slave bot where the slave bots are commanded by the master through wireless communication and hence has applications in several industries, in hazardous waste management, in defense etc.

II. Literature Survey

Swarm robotics, the proposed research area is provoked from the biologic system such as the flock of birds or colonies of bee and insects etc. It includes numerous small robots which are employed on fundamental operation possessing the ability to accomplish complicated collaborative behaviour on swarm level such as design configuration and gathered movement. The prevailing situation of swarm robots and their application and the possibility of their ability to solve day to day problems are discussed.[1] Swarm robotics is basically a fresh perspective to the synchronization of multiple robotics systems which comprises of an enormous number of the basic physical robots working together.[2] Swarm robotics being a unique and unfamiliar outlook on the coordination of multiple robot systems contains massive numbers of contemporarily easy robots that is influenced by native insects. The foremost vital features of swarm robots are the potential to carry out a task synchronously to accomplish a mutual aim [4]

The upcoming research in swarm robotic designing is taken from the swarms in nature. It has wide-reaching applications in rescue operations, disaster management, defence, oil splits etc. [3] In swarm robotics, it's essential to build up the methodology and the plan that supervise the collective completion of tasks by the robots. The patterns of such tasks are typically done by accounting it as a group of basic, easy and uncomplicated behaviours, named as subtasks. [5] Swarm robotics is happening to be a swiftly rising field that drives the concept from swarm intelligence. It's an appealing choice over the orthodox point of view to robotics as they contain some characteristics of issue solving, observed in numerous insects, which are adaptable, adjustable, sturdy, synchronized, cooperative and self-organized. This provides birth to the probabilities for future analysis. [6]

III. Technical Description
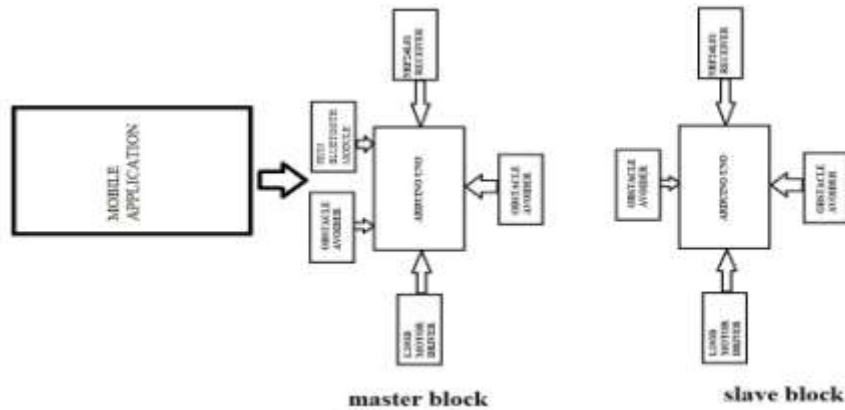
1.Block diagram

Fig1: MASTER AND SLAVE BLOCK DIAGRAM

The block diagram consists of three major block 1. The mobile application 2. Master Block 3. Slave Block. The Mobile application and the master bot is linked using a Bluetooth module HC05 through which the master receives commands for a particular task. The master block has the NRF24L01 transmitter and slave block has the receiver of NRF24L01. Also, a motor driver L293D is employed in master and slave block together with an ultrasonic sensing element for obstacle avoiding purpose. For the link between the hardware and code Arduino Uno has been used

2. Block diagram description

Arduino Uno -Arduino Uno is used for the alliance between the hardware and the software. Two UNO's are used in the project in the master and slave bot

RF Module (nrf24l01): this module is used for the intercommunication between the bots using the transmitter and receiver modules mounted accordingly on the master and slave

Obstacle Avoider (Ultrasonic sensor): The sensor is used to ward off concussion Motor Driver (L293D)- The L293D is a 16-pin Motor Driver IC which can supervise a pair of two DC motors in any direction the same time

HC05- HC-05 module is a Bluetooth module used as a collocation between the mobile android app and the master bot to deliver the instruction.
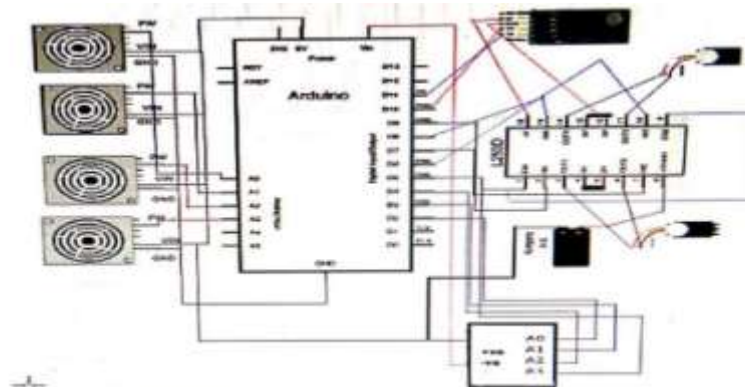
3. MasterWorking

Fig.2: MASTER CIRCUIT DIAGRAM

As shown in the fig.2 the master diagram has elements like Arduino UNO, HC05, NRF24L01, L293D, ultrasonic sensors, motors, and a 9v battery. For obstacle rejection purpose 2 ultrasonic sensors are placed diagonally on the master on pin no A0, A1 of the Arduino. Here in the master bot, the commands are received through the mobile application using the HC05 Bluetooth module. The command will be sent from the application to the master bot using HC05 (Bluetooth module) and accordingly, the information will be transferred to the other components.

The TX pin of HC05 which is allied to RX pin (D0) of Arduino. The NRF24L01 RF module is passed down for the communication between the master bot and the slave bot. The NRF24L01 component's MISO pin is connected to D12, MOSI to D11, CE to D9, and SCK to D13.Further, the data to the wheels is shared through the motor driver circuit that includes a motor driver IC L293D of that the output pins (3,6)are allied to one motor and other 2 output pins(11,14) are associated to the second motor. Whereas the input pins are associated to Arduino (2-D10,7-D7,10-D8,15-D6).As the master will work accordingly the slave will move
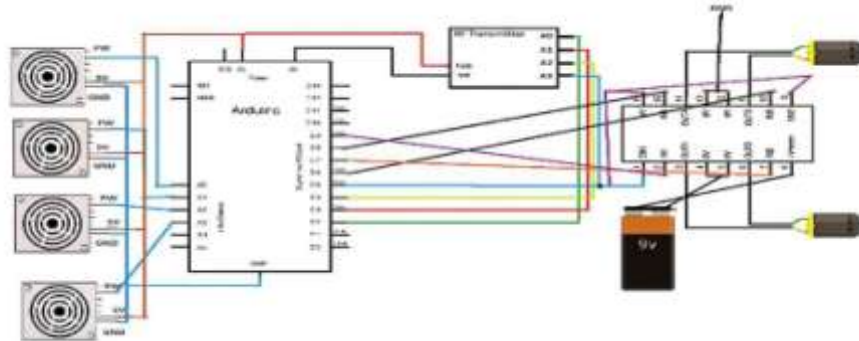
4.Slave Working

Fig.3: SLAVE CIRCUIT DIAGRAM

As shown in the fig.3 the slave diagram has elements like Arduino UNO, NRF24L01, L293D, ultrasonic sensors, motors, and a 9v battery. The connection is the same as the master circuit except for the HC05.Using the RF module the communication between the master and slave will take place. For e.g. If a box is to be moved from one place to a different therefore as shortly as we provide the command from the app to the master to move the box from destination one to destination 2, It will transfer the commands to the other slaves (can make many slaves) and accordingly the master and slave will complete the task to move the box from destination 1 to destination 2. Using the app, the master and slave can move in all direction and can go in remote places where humans cannot go for e.g. In industries where humans cannot go due to high risk, these swarm bots can be sent there to perform the task with utmost precision and with no risk

IV. Conclusion

The proposed paper suggests the plan of swarm robotics where the master and the slave robots correspond with each other in a parallel and logical manner. Instructions given by the android application to the master bot are recognised and applied to the slave bots effectively. Co-ordination and synchronization among bots is achieved successfully while traversing on the ground. The noteworthy advantages of swarm robots are group task achievement and need of complex algorithms is eliminated, scalability and stability. Swarm robotics has a great potential to combat the issues faced in our surroundings. It is useful in applications like disaster mitigation, military, industrial and agricultural purpose.

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