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Controlling Robot via Robot Using Time Varying Solidity Utility

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ABSTRACT: Multi-robot systems (MRS) are a group of robots that are designed aiming to perform some collective behaviour . An approach is presented for influencing teams of robots by means of time-varying density functions, representing rough references for where the robots should be located. A continuous-time coverage algorithm is proposed and distributed approximations are given whereby the robots only need to access information from adjacent robots. Multi-robot consists of master robot and slave robot. Slave robot which follows the master robot. Master robot is controlled by Bluetooth via mobiles or PC and the slave robot is controlled by master using RF communication. The application allows the robot control interaction with the display, or voice. Using a graphical interface, the current distance of the robot from obstacles can be monitored. The measurement of distance is carried out by ultrasonic sensor placed in front of the robot. Ultrasonic Sensor finds any obstacles it stops the motors and transmit stop signal to slave device what will happen the slave robot get stopped instantly. The master robot send the signal via RF transmitter to slave device which receive the signal and work same as master.

KEYWORDS: multirobot teams, time varying solidity utility, coverage control

I.INTRODUCTION

A robot is a re-programmable multifunctional manipulator. Multi-robot systems (MRS) are a group of robots that are designed aiming to perform some collective behaviour. By this collective behaviour, some goals that are impossible for a single robot to achieve become feasible and attainable. These benefits include resolving task complexity which means some tasks may be quite complex for a single robot to do or even it might be impossible. This complexity may be also due to the distributed nature of the tasks and/or the diversity of the tasks in terms of different requirements. Increasing the performance is that the task completion time can be dramatically decreased if many robots cooperate to do the tasks in parallel. Increasing reliability refers to increasing the system reliability through redundancy because having only one robot may work as a bottleneck for the whole system especially in critical times. But when having multiple robots doing a task and one fails, others could still do the job. Simplicity in design means having small, simple robots will be easier and cheaper to implement than having only single powerful robot.

In order to develop and deploy robust MRS in real world applications, a number of challenging problems needs to be solved. Utility is a unifying, if sometimes implicit, concept in economics, game theory, and operations research, as well as in multi-robot coordination. It is based on the notion that each individual can internally estimate the value or the cost of executing an action. Depending on the context, utility is also called fitness, valuation, and cost. Within multi-robot research, the formulation of utility can vary from sophisticated planner-based methods to simple sensor based metrics. The utility estimation of this kind is carried out somewhere in every autonomous task allocation system, for the heart of any task allocation problem is comparison and selection among a set of available alternatives. Since each system uses a different method to calculate utility, gives the following generic and practical definition of utility for multi-robot systems. It is assumed that each robot is capable of estimating its fitness for every task it can perform. This estimation includes two factors, which are both task and robot-dependent expected quality of task execution, given the method and equipment to be used (e.g., the accuracy of the map that will be produced using a laser range-finder) and expected resource cost, given the spatio temporal requirements of the task (e.g., the power that will be required to drive the motors and laser range-finder in order to map the building). The robots utility estimates will be inexact due to sensor noise, general uncertainty, and environmental change.

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II.SYSTEM MODEL AND ASSUMPTIONS

An approach to externally influencing a team of robots by means of time-varying density functions is presented. These density functions represent rough references for where the robots should be located. To this, a continuous-time algorithm is proposed that moves the robots so as to provide optimal coverage given the density functions as they evolve over time. As with the algorithms for time-invariant density functions, CVT (centroidal Voronoi tessellations) will play a key role. A CVT is a configuration where the positions of each robot coincide with the centroids of their Voronoi cells, given a so called Voronoi tessellation of the domain of interest. The algorithm proposed in this paper will achieve optimal coverage by first letting the robots converge to a CVT associated with a static density function as an initialization step, and then have the robots maintain the CVT as the density function starts evolving over time. Assume the sensors location obeys a first order dynamical behaviour described by

$$p_i = u_i$$

Consider H_V a cost function to be minimized and impose that the location p_i follows a gradient descent. In equivalent control theoretical terms, consider H_V a Lyapunov function and stabilize the multi-vehicle system to one of its local minima via dissipative control. Formally,

$$u_i = -k_{prop}(p_i - C_{Vi})$$

where k_{prop} is a positive gain, and where assume that the partition,

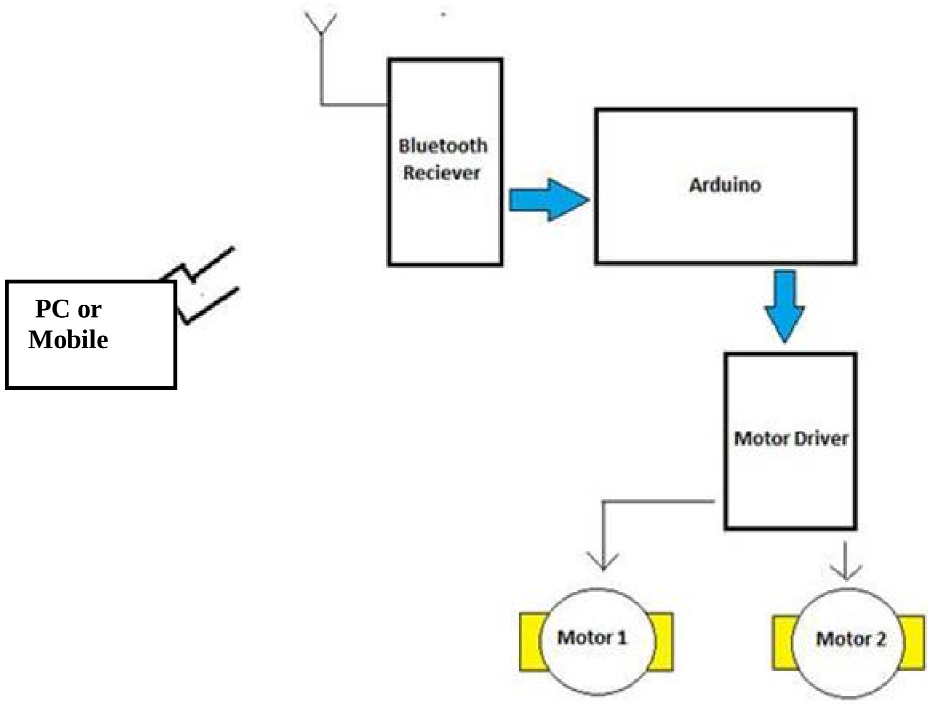
$$V(P) = \{V_1 ...... V_n\}$$

is continuously updated.

For the closed-loop system induced by the above equation, the sensors location converges asymptotically to the set of critical points of H_V, i.e., the set of centroidal Voronoi configurations. Assuming this set is finite, the sensors location converges to a centroidal Voronoi configuration.

III.BLOCK DIAGRAM

The system contain microcontroller unit, Bluetooth module , an RF Transmitter, Ultrasonic sensor, LCD unit and Motor driver. Master robot is controlled by Bluetooth via mobiles or PC.



3.1 Block diagram for master control

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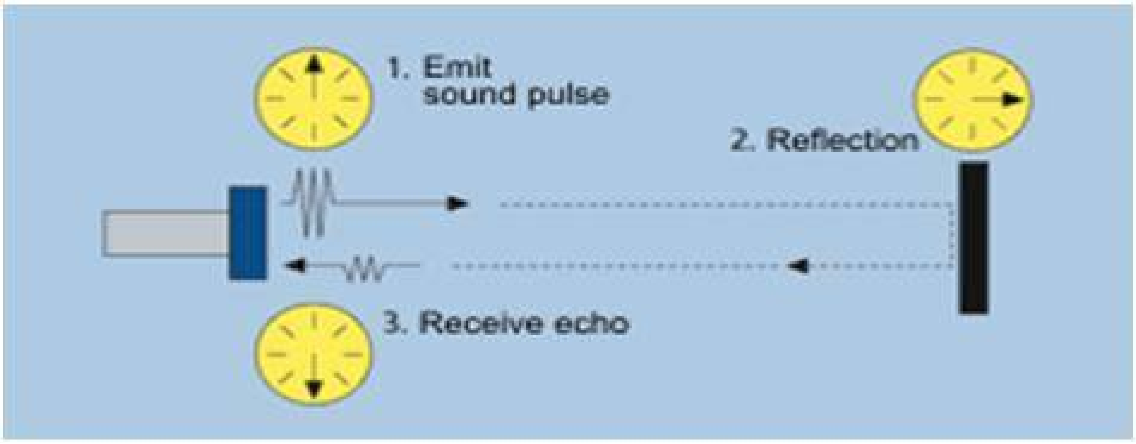
Bluetooth device is interfaced to the control unit on the robot for sensing the signals transmitted by the android application. This data is conveyed to the control unit which moves the robot as desired. An 8051 series microcontroller is used as control device. Transmitting end uses an android application device remote through which commands are transmitted. At the receiver end, these commands are used for controlling the robot in all directions such as forward, backward and left or right etc. At the receiving end the movement is achieved by two motors that are interfaced to the microcontroller. Serial communication data sent from the android application is received by a Bluetooth receiver interfaced to the microcontroller. The program on the microcontroller refers to the serial data to generate respective output based on the input data to operate the motors through a motor driver IC. The motors are interfaced to the control unit through motor driver IC.

3.1 Obstacle detection

Ultrasonic Sensor finds any obstacles it stops the motors and transmit stop signal to the device what will happen the robot get stopped instantly. When an electrical pulse of high voltage is applied to the ultrasonic transducer it vibrates across a specific spectrum of frequencies and generates a burst of sound waves. Whenever any obstacle comes ahead of the ultrasonic sensor the sound waves will reflect back in the form of echo and generates an electric pulse. It calculates the time taken between sending sound waves and receiving echo. The echo patterns will be compared with the patterns of sound waves to determine detected signal's condition.

Test distance = (high level time× velocity of sound (340M/S)) / 2.



3.2 ultrasonic working principle

The ultrasonic receiver shall detect signal from the ultrasonic transmitter while the transmit waves hit on the object. The combination of the sensor will allow the robot to detect the object in its path. The ultrasonic sensor is attached in front of the robot and that sensor will also help the robot navigate through the hall of any building.

3.2 Control Algorithm

The position control algorithm allowed the robot to approach its target distance at any speed. Then, as the target approached, it would slow its speed so that it could stop accurately when desired. This was achieved with a simple algorithm diagrammed below.

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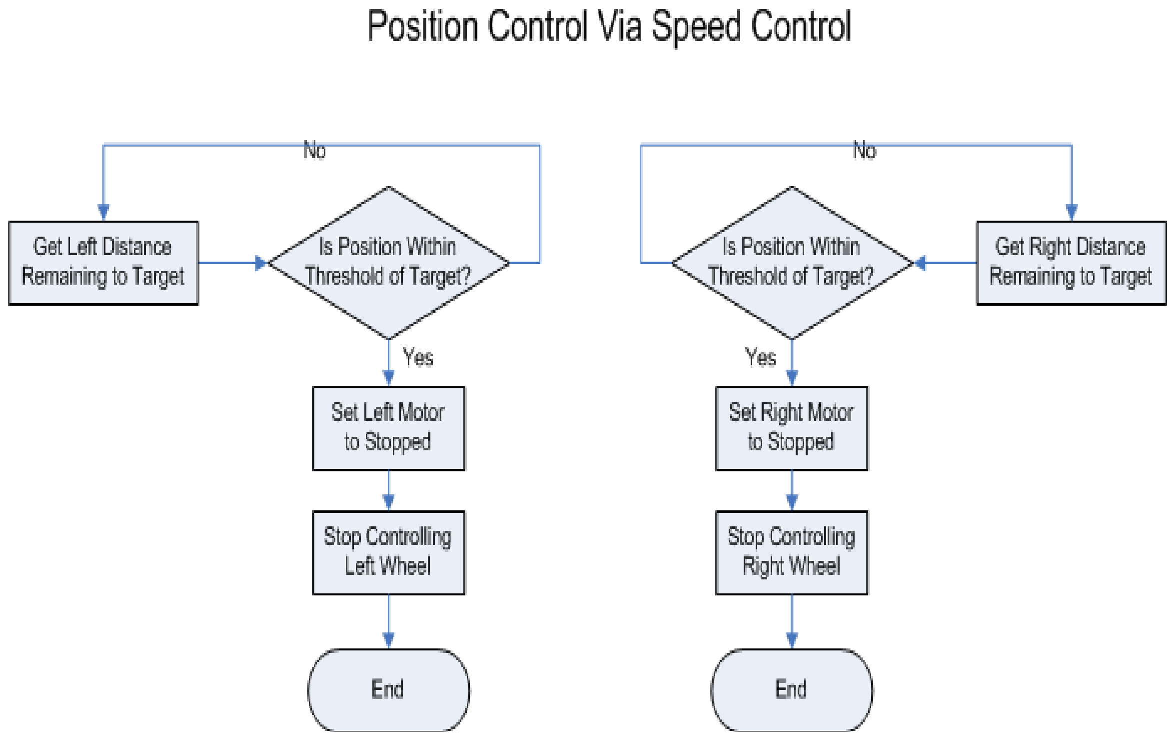

3.3 Flow Diagram

IV. RESULT AND CONCLUSION

This system presents a novel coverage algorithm that can handle time-varying density functions, as well as lend itself to a distributed implementation, and experimental results demonstrate the viability of the proposed approach. The main idea is to combine a proportional term driving the robots to the centroid of their Voronoi cells with a controller tracking the time-varying evolution. It should be noted, however, that in practice, input saturations, modeling errors associated with the single integrator dynamics, and aggressively varying density functions make the robots temporarily deviate from their centroid on occasions. This fact seems to indicate that this paper should be thought of as a first step toward handling time-varying density functions and that more robust and responsive methods can be developed as future endeavors. The generation of effective density functions from human inputs is another issue that will be pursued in the future, as well as the introduction of obstacles and non-convex areas of interest.

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