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AGRO-ROBOSPHERE

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Abstract *-The surveillance and inspection tasks in large exterior critical infrastructures have arisen as critical processes. More complex challenges are now present, and the traditional approaches are sometimes obsolete for facing these new menaces. This gives rise to an alternative system which comprises of a spherical ball,with some sensors and motors which provides a flexible, versatile and reliable way to perform measurements. Spherical robots aren't new. There have been a number built over the years for use in military operations,security, and experiments in space exploration. The approach is to take the simplicity of the sphere to make a robot that is low cost and a bit more general purpose.*

Its spherical shape gives the robot the ability to handle rough terrain, yet is safe to use around humans all-terrain vehicle that guarantees a safe and friendly interaction with the environment. The performance is based on a principle of relative simplicity involving the understanding of an essential physics concept: the center of mass.

***KeyWords*:Agro-Robosphere, the center of mass, wireless data transfer,moisture sensoring**

1.INTRODUCTION

The idea to build a laboratory spherical robot arised in the Unit of Foundations of Cybernetics and Robotics in connection with research works on kinematics singularities of nonholonomic robots . The initial concept of construction of such a robot called RoBall,in particular - the concept of its driving system, was presented on the seminar on 4th May,
2000. The preliminary design specifications of tyhe Ro-ball includes two dc motors which provide the driving torques which are related to two DOF around the pedulum hanging
in the centre of the spherical shell. RoBall is intended to be a real object equipped with sensors, drives, and an embedded controller, what will enable users to implement and test
their own control algorithms.

This project describes a type of mobile robot with a spherical shape designed to act as a platform to carry sensing devices or actuators in an environment where the conditions are harsh and the stability of the mechanical platform is critical. A remotely controlled internal unit drives the spherical robot. The motion controller was designed to drive the robot to the desired path using control based on the path curvature. The robot steers by controlling the displacement of its centre of gravity. Critical infrastructures (CIs) are those physical and information technology facilities,networks,services, and assets which, if disrupted or destroyed, would have a serious impact on the health,safety, security, or economic well-being of citizens or on the effective management, and governanceof a country.

Their security and effective surveillance have become challenging requirements that must be taken into account when designing the operation and integrated functioning of the essential elements of the installation.Exterior critical infrastructures (ECIs) present common characteristics, mainly their size(i.e., usually quite large) and location (i.e., commonly far away from highly populated areas), that permit to group and study their security and surveillance under a common scheme. The most important characteristic to design robot intended for an ECI monitoring is its reliability and robustness. They imply that the robot must remain stable and provide the same performance regardless ofthe external conditions, at both the hardware and software levels. The ECI location,typically in remote scenarios, may result in exposing the robots to hard conditions such as heavy rains, extreme temperatures, or dusty winds.

It can also be expected that a part of the installation is made of rough terrain and that the different weather conditions along with the different seasons of the year alter significantly the conditions of the environment.For example, there can be snow or ice sheets in winter,puddles or muddy areas in autumn, or sandy and crumbly grounds during summer.All these factors affect directly the design of the movement mechanism, probably the most important element of the robot. Moreover, the traction system needs to
be versatile and able to displace the robot along with the different types of surfaces, from urbanized even terrains where the robot might slide to rough

nonstructuredsurfaces.The traction system should allow the robot to follow trajectories with sharp angles and narrow passages. Due to the size of the infrastructure, another important factor is the autonomy of the sensing platform. These robotic platforms should be able to perform continuous monitoring for several hours without recharging.

2.WORKING-MECHANISM-PRINCIPLE

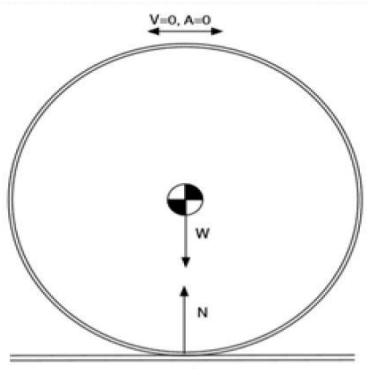
This project proposes an efficient system that measures and monitors the moisture content in agricultural fields. It comprises of RF transmitter and receiver , arduino uno,arduino joystick for control mechanism , servo motor , geared dc motor , moisture sensor and hamster ball.

2.1Working

The objective of this work is to present a rolling robot with a spherical shape, called robotic sphere (ROSPHERE), as an alternative mobile platform to perform monitoring and inspection tasks. In contrast to other mobile robots (e.g., walking systems) whose basic locomotion principle is the system stability, movements in robotic spheres are induced by instability. Another consequence is that, due to its regular shape, the robot recovers easily from collisions so that, regardless the direction of the impact, the robot always tends to fall into a recoverable configuration

Figure-1

Balanced configuration

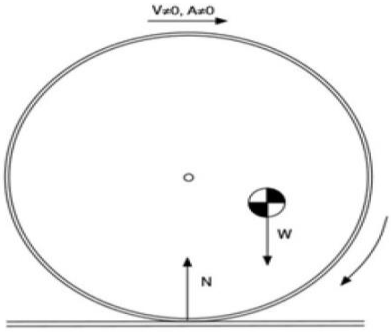


Herein, in order to have a global view of the robot capabilities, we will analyze the internal mechanism which endows the system with these characteristics. Let us consider first a sphere where mass is uniformly distributed. In this case, the center of mass (CM) is coincident with the geometrical center. Also, if the sphere is in contact with a nonlifted surface, the projection of the CM over the surface will be at the contact point. Under these conditions, the sphere will have neither acceleration nor velocity in any possible direction(i.e., the sphere is at rest).

If a sphere is built by using a nonuniform material, its CM would not be located at its geometrical center. In this case, when placing the sphere on a flat surface, the projection of the CM over that surface will not coincide with the contact point and it will overturn until reaching an equilibrium configuration .position of the CM, can be defined arbitrarily,the spherical system would be able to self-induce movement in any possible displacement direction (i.e., a holonomic system). That is, the basic principle of locomotion in a robotic sphere, a spherical- shaped vehicle that includes an internal mechanism which permits to vary the position of the CM and, therefore, to self-induce motion.Finally, if the distribution of mass, i.e., the position of the CM, can be defined arbitrarily,the spherical system would be able to self-induce movement in any possible displacement direction (i.e., a holonomic system). That is, the basic principle of locomotion in a robotic sphere, a spherical-shaped vehicle that includes an internal mechanism which permits to vary the position of the CM and, therefore, to selfinduce motion.

Figure-2

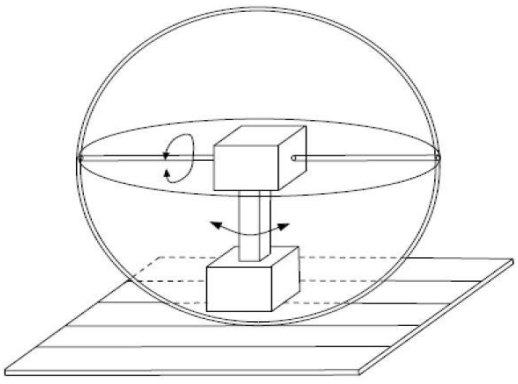
Unbalanced configuration



3.SYSTEM DESIGN AND COMPONENTS

Figure-3

Constructional details



ROSPHERE has an inner two degrees-of-freedom pendulum. Figure4.1 shows a general
concept of the mechanism, including its main parts:
(a) the spherical-shaped body
(b) a fixed main axis
(c) a central unit or internal control unit (ICU, as defined by other authors)
(d) the ballast or hanging mass.
The first DoF allows the rotation of the ICU, and consequently of the hanging mass
around the fixed axis. For this rotation, a continuous rotation actuator with no angle limit is needed. The second DoF, on the other hand, has a limited rotation range, which ideally should be 180 deg. A Hamster ball was used as the main spherical body.

This ball can be separated in two hemispheres with caps where the main aluminum axis was fixed. All the other parts of the model, including the pendulum and the ICU,In the designing of agrorobosphere an important factor is the angle required to induce motion to the system. This angle depends on different factors from which the most important one regarding the mechanics is the relative position of the CM with respect to the geometrical center. In other words, further the CM is from the geometrical center, the smaller the angle needed to produce motion.

3.1MAIN COMPONENTS

3.1.1 Hamster ball
Hamster balls are hollow spheres made of clear plastic into which hamsters, gerbils, degus and other small rodent pets are placed, allowing them to run around outside their cages without the risk of running away, getting lost under furniture or in walls.

3.1.2 Arduino uno
The Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. Itcontains everything needed to support the microcontroller; simply connect it to a computer
with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software(IDE) . The Uno board and version of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive
list of current, past or outdated boards see the Arduino index of boards.

Arduino UNO is the most popular among the arduino family.Uno is more frequently used by hobbyist for their project work.It has an inbuilt voltage regulator so that
sudden rise in voltage will regulated.Hence arduino Uno is the one that is most suitable for this project.

3.1.3 Geared dc motor
A geared DC Motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM .The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gears in a gear motor, its speed can be reduced to any desirable figure. This
concept where gears reduce the speed of the vehicle but increase its torque is known as gear reduction. This Insight will explore all the minor and major details that make the gear head and hence the working of geared DC motor.

3.1.4 Arduino joystick
The joystick in the picture is nothing but two potentiometers that allow us to measure the movement of the stick in 2-D. Potentiometers are variable resistors and, in a way, they act as sensors providing us with a variable voltage depending on the rotation of the device around its shaft. In other words this means that our sensors are characterized with a value
between 0 and 1024.

3.1.5 RF Transmitter and Receiver
The RF module, as the name suggests, operates at Radio Frequency. The corresponding frequency range varies between 30 kHz and 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK).

Transmission through RF is better than IR (infrared) because of many reasons. Firstly, signals through RF can travel through larger distances making it suitable for long range applications. Also, while IR mostly operates in line-of-sight mode, RF signals can travel even when there is an obstruction between transmitter and receiver. Next, RF transmission is more strong and reliable than IR transmission. RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources.

3.1.6 L293D IC
L293D is a Motor driver integrated circuit which is used to drive DC motors rotating in either direction. It is a 16-pin IC which can control a set of two DC motors simultaneously.
The L293D uses 5V for its own power and external power source is needed to drive the motors, which can be up to 36V and draw up to 600mA.

The L293D works on the concept of typical H-bridge, a circuit which allows the high voltage to be flown in either direction. In a single L293D IC there are two H-

bridge circuits which can rotate two DC motors independently. Due to its size and voltage requirement, it is frequently used in robotics applications for controlling DC motors, including in Arduino projects.

3.1.7 7805 Regulator

A regulated power supply is very much essential for several electronic devices due to the semiconductor material employed in them have a fixed rate of current as well as voltage. The device may get damaged if there is any deviation from the fixed rate. The AC power supply gets converted into constant DC by this circuit. By the help of a voltage regulator DC, unregulated output will be fixed to a constant voltage. The circuit is made up of linear voltage regulator 7805 along with capacitors and resistors with bridge rectifier made up from diodes.

As we have previously talked about that regulated power supply is a device that mechanized on DC voltages and also it can uphold its output accurately at a fixed voltage all the time although if there is a significant alteration in the DC input voltage. ICs regulator is mainly used in the circuit to maintain the exact voltage which is followed by the power supply.

3.1.8 Moisture Sensor

Two copper leads are used as moisture sensor. This is dipped in the soil and checks the moisture content present. Measuring soil moisture is important step in deciding the
duration of the irrigation. Advanced versions of moisture sensor have options to set the desired moisture level with the rotary knob and also features wireless transfer of collected data from the field to the control unit.

Cheaper sensors model can be made of two electrodes measuring the resistance of the soil between the leads. The current is passed through the probes. The resistance of the soil varies with the moisture content in it. Thus the amount of the current flow increases with the moisture in the soil. The prototype design included resistor type sensor with the desired moisture level included in the program of the microprocessor.

3.1.9 LCD display

The LCD display is used to display various voltages and instructions to users. A liquid crystal is a material (normally organic for LCDs) that will own like a liqud butwhose molecular structure has some properties normally associated with solids. A 16*2 LCD means it can display 16 characters per line and there are 2 such lines. LCD each character is displayed 5*7 pixel matrix. This LCD has two registers, namely Command and Data.

The Command register store the command instructions given to the LCD. The Data register stores the data to be displayed on the LCD. The Liquid Crystal Display (LCD) is a low power device. The power requirement is typically in order of microwatts for the LCD. However, an LCD requires an external or internal light source. It is limited to a temperature range of about 0K to 333K and lifetime is an area of concern, because LCDs can chemically degrade.

3.1.10 Servomotor

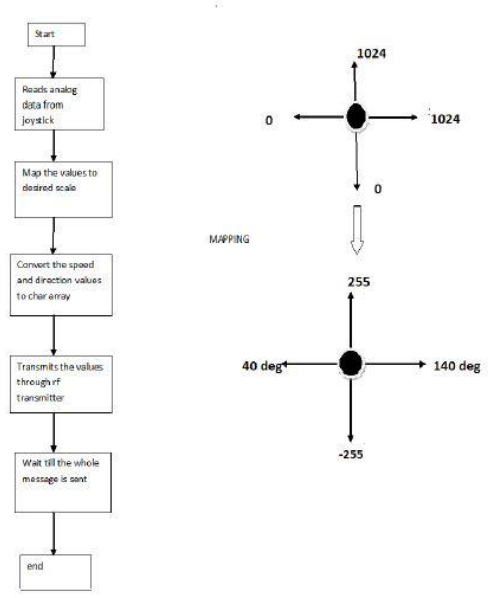
Servos are small mechanical devices whose sole purpose is to rotate a tiny shaft extending from the top of the servo housing. Extending from the side of the servo is a thin cable comprised of three wires. Two of the wires are used to send power to the servos motors and one wire is used to send commands from the arduino to the servo.

Each servo has a built-in processor that responds to electrical pulses sent to it. The arduino creates an electrical pulse by sending voltage to one of its pins for a very specific
amount of time. The microcontroller cannot control how much voltage is sent it simply turns the voltage on or off. When the voltage is on, the arduino outputs +5V. When the voltage is off, 0V is output. The arduino can turn the output voltage on and off rapidly, thereby creating pulses of high and low voltages

4 FLOWCHART

Figure-4

Trnsmitter



The analog data ranging from 0 to 1024 is read from joystick.Now the data is mapped to desired value as shown in figure.Convert the speed and direction values to char array. Now transmit the value through RF transmitter. Now wait till the whole message is sent.

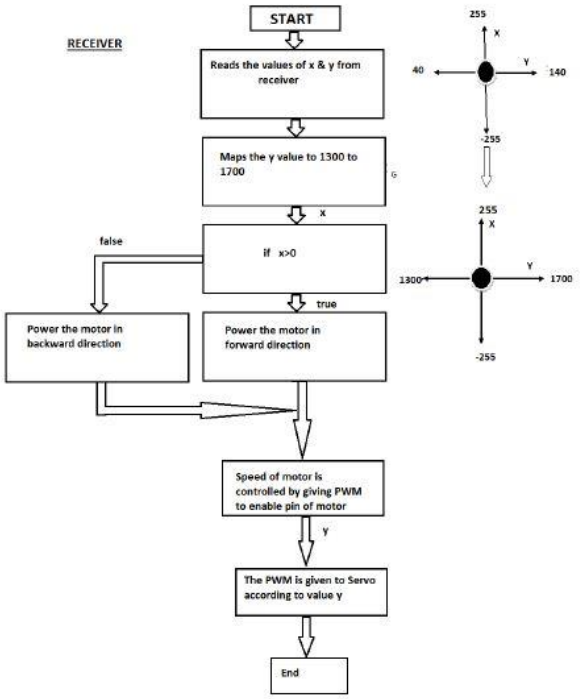
Figure-5

Receiver

First read the values of x and y coordinates from the receiver. x value determines the speed and y value determines direction. Then the microprocessor maps the obtained y value in between 1300-1700. Then check the x

value. if x greater than 0 and if the conditional statement is true,power the motor in the forward direction and if the condition is not fulfilled power the motor in the reverse direction.

Speed of motor is controlled by giving PWM to ENABLE pin of motor shield. PWM is given to servo according to value y.



5.CONCLUSION

ROSPHERE can roll through rows of crops gather information (moisture , humidity ,temperature) about of soil and plants . The data it generates could be of particular use to farmers and scientists interested in precision farming. Studies can be carried out for developing proper tool for easily assessing the required water demand for a particular crop for a particular site.

Poor management of water resources and changing climatic conditions results in reducing ground water table in many parts of the country. Studies can be done in proper management of ground water and surface water resources. Automated irrigation systems will be a need of the future as India is going to face severe water crisis in near future. Future scope of this agro-ball includes installing a gyroscope for improved stability.

This may add to the cost as it includes integration of faster arduino boards,but this may enhance the scope of the ball as more advanced sensors like mineral sensors could be
integrated. This enables the agro-balls in measuring soilfertility. Another advancement,includes installing WiFi module for controlling the Rosphere through internet , from any corner of the world.

REFERENCES

[1] S. Gora, M. Wnuk VFMC" *Freely programmable robot motion controller*". Report SPR 13/97, Inst. of Eng. Cyb., Wroclaw Univesity of Technology, 1997 (in Polish).

[2] P. E. Rybski et al., A team of robotic agents for surveillance, in Proc. 4th Int. Conf. Autonomous Agents (AGENTS 00), pp. 916, ACM, New York, NY, USA (2000).

[3] R. H. Armour and J. F. V. Vincent." *Rolling in nature and robotics: a review"*, J. Bionic Eng. 3(4), 195208 (2006), http://dx.doi.org/10.1016/S1672-6529(07)60003-1.

[4] A. Bicchi et al. Introducing the *"SPHERICLE: an experimental testbed for research and teaching in nonholonomy"*, presented at the IEEE International Conference on Robotics and Automation, Vol. 3, pp. 26202625
(1997),http://dx.doi.org/10.1109/ROBOT.1997 .619356.

[5] R. Marigo, A. and Bicchi, A. A. *"Rolling bodies with regular surface: controllability theory and application"*. IEEE Trans.Autom. Control, September 2000, 45(9).

[6] M. Kaba, K. Tchon, M. Wnuk. *"A mobile robot driven in internal coordinates"*. In VII KKR, Ladek Zdrj, 2001, Inst. of Eng. Cyb., Wroclaw Univesity of Technology,Conferences 46, t.1, pp. 149-158 (in Polish).