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Autonomous Robot for Identification of Soil Parameters and Collecting Scrap from Farm

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Abstract: According to UNICEF solid waste can be classified into biodegradable and non biodegradable. Non biodegradable wastes cannot be decomposed by biological process. Plastics and other metals in agricultural field cause many troubles. The presence of these materials causes soil degradation. Common attributes of soil degradation can be salting, waterlogging, compaction, pesticide contamination. It also decline in soil quality, fertility loss, acidity, alkalinity, salinity, and erosion. Soil degradation also has a huge impact on biological degradation, and chemical transformation properties of the soil. In Modern world, Automation robot is used in many of the fields such as defense, surveillance, medical field, industries and so on. In this paper, the robot system is used to identify the soil parameters such as humidity, temperature and soil moisture and conducting and non conducting materials from the farm and remove it from the farm autonomously. . The presence of these scrap make the land infertile. The aim of the paper is to reduce the man power, time and to make the soil fertile. In order to avoid this, our robot will pick up the unwanted scrap from the farm. Here we use arduino as a controller. In our project we use RFID technology for robot navigation in the farm. For identifying the materials in the soil we use inductive and capacitive proximity sensors. Ultrasonic sensors are used for obstacle detection. For removing these materials we use pick and place robot.

Keywords: Arduino Mega 2560, Capacitive sensor, Inductive sensor, Ultrasonic sensor, RFID tag, RFID reader.

I. INTRODUCTION

In current generation most of the countries do not have sufficient human factor in agricultural sector and it affects the growth of developing countries so it's time to automate the sector to overcome this problem. In India, there are 70% people dependent on agriculture. So we need to study the agriculture. Hence we identify the soil parameters and intimate the owner. Innovative idea of our project is to make agriculture simpler by removing the unwanted scrap from farm autonomously. The presence of unwanted materials such as plastics make the land infertile. It destructs the growth of crops. Hence we identify those unwanted materials and remove it from the farm to make the land fertile autonomously. Hence there is no need for human intervention in the field. Our robot will pick those scrap and remove it from the field.

For robot navigation we use RFID technology. RFID tags are to be placed as landmarks in the field. RFID reader is to be placed in our robot. Robot will make the source itself. The reader has an antenna that emits radio waves; the tag responds by sending back its data. When the signal is detected by the reader, the robot will stop and take the corresponding path. The robot automatically moves along the farm using the scanned range data until a tag is found. Ultrasonic sensors are placed in the robot for obstacle detection. Capacitive sensors are used here to identify the non conducting materials such as plastics in the soil. Inductive sensors are used to identify the metals in the soil. In order to remove these materials we use pick and place algorithm. Robotic arm placed in the robot picks up the unwanted scrap from the field. For the robotic arm we use four servomotors for angle rotation. When sensors are detected, then the servomotors will rotate in their corresponding angles and pick the scrap from the field. Thus our robot removes the unwanted scrap from the farm autonomously.

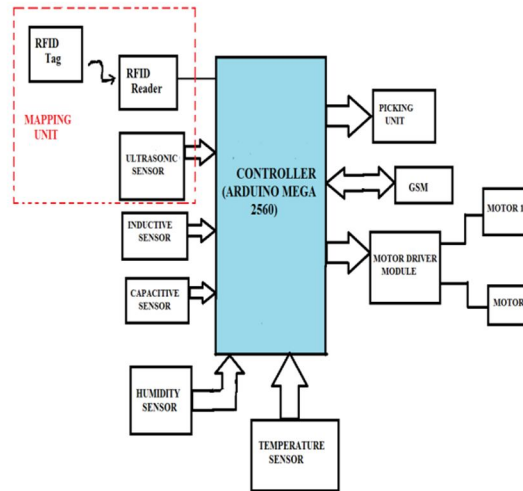
II. PROPOSED METHOD

In the existing method, the soil parameters such as humidity of soil, soil moisture, temperature of soil etc are monitored. These parameters are checked periodically and intimate to the owner in regular intervals of time using GSM technology. If the soil moisture level gets low, then motor will ON and water supply is given to the farm. These are the existing methods. In addition to that, Our proposed method is to identify the unwanted scrap and remove it from the farm autonomously. Soil quality is also so important as soil parameters. Presence of scrap may reduce soil quality. To overcome this we make a robot for identifying these things and remove it. For robot navigation purpose we use Radio Frequency Identification Technology. It is cost effective. Because RFID tags and reader cost is efficient. For pick and place mechanism we use servomotors. Two proximity sensors are used to

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identify the unwanted scrap present in the farm.

A. Block Diagram



B. RFID Technology

We interface an RFID Reader which can read RFID Tags to Arduino. An RFID reader is used to read RFID tags (which contain certain unique data stored in a chip). An RFID reader and an RFID tag, both have coils. When an RFID tag is near Reader, it collects the unique tag data from the RFID tag. when an RFID tag is shown near the reader, electromagnetic induction induce between the coils and powers the chip. The chip sends data electromagnetically to the reader. The reader will receive this data and outputs serially. Every RFID reader has serial output pins. We read data through these serial pins using arduino.

The RFID tags are patched in the field and the robot has the RFID reader connected to it. Whenever the RFID reader shown nears the tag in land, it reads the data from the tag. According to the data received from this tag, the robot turn to take its path. The robot navigates in a fixed path.

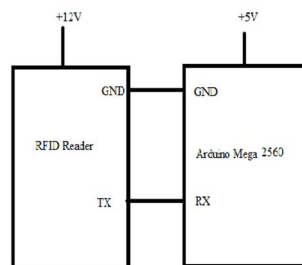
The ultrasonic sensors were placed at either side of the robot to avoid collision at walls.

- 1) *Sensing Unit:* The sensing unit in our project consists of RFID tags and the ultrasonic sensors.
- 2) *RFID Tags:* The RFID tags will consists a unique number for each and every tag. Due to electromagnetic waves, the data from the tag will be passed to the RFID reader that will further given to the arduino for further processing.
- 3) *RFID Reader:* A Passive Reader Active Tag (PRAT) system has a passive reader which receives radio signals from active tags. The reception range of a PRAT from 1–2,000 feet allowing flexibility in asset protection and supervision.

An Passive Tag system has an active reader, which transmits interrogator signals and receives authentication replies from passive tags.

An Active Tag system uses active tags with an interrogator signal from the active reader. This system also use Battery-Assisted Passive tag which acts like a passive tag but has a small battery to power the tag's return signal.

Fixed readers are set to create a specific interrogation zone. This allows a highly defined reading area for when tags go in and out of the zone. Mobile readers may be mounted on vehicles.



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- 4) *Ultrasonic Sensor*: The ultrasonic sensor is used to find the obstacles present in the location. It will generate the ultrasonic waves whenever the robot moves near to the obstacle the waves will be reflected back and the ultrasonic receiver will detect it and interrupts the controller.

C. Sensing Unit

Sensing unit consists of two sensors to detect the unwanted scrap in the field.

- 1) *Two Sensors*: Inductive sensor is used to detect the conducting materials which are present in the farm. To detect plastic materials capacitive sensor is used.
 - a) *Inductive Sensor*: An inductive proximity sensor is a non-contact electronic sensor used to detect the position of metal objects. The sensing range of an inductive switch is dependent on the type of metal being detected. The sensor consists of an induction loop. Electric current generates a magnetic field, which collapses generates current falls toward zero from its initial value when the input electricity comes. The inductance of the loop changes according to the material and such metals are more effective than other materials. The presence of metal increases current flowing through the loop. This change be detected by sensing circuitry, which can signal to some other device whenever metal is detected. Common applications of inductive sensors such as metal detectors, traffic lights, car washes and in automated industrial processes. Because these inductive sensors does not require physical contact, it is particularly useful for applications where dirt is prevalent.
 - b) *Capacitive Sensor*: Capacitive sensors are used for the non-contact detection of plastics and for level monitoring. Typical applications are in the wood, paper, glass, plastic, food and chemical industries. The main difference between the inductive and capacitive sensor is that capacitive proximity sensors produce an electrostatic field instead of an electromagnetic field. Capacitive proximity switches sense nonmetallic materials such as paper, glass, liquids, and cloth.
- 2) *Sensors to Check the Soil Parameters*:
 - a) *Humidity and Temperature Sensor*: The RHT03 is a low cost humidity and temperature sensor with simple wire digital interface. These sensors are used to check the humidity and temperature of the soil.
 - b) *Soil Moisture Sensor*: Sparkfun soil moisture sensor is used to check the moisture content of the soil. If the moisture content is below the threshold value then the motor control for tank gets on.
 - c) *GSM Module*: The GSM module is interfaced with arduino. The soil parameters are checked and it is intimated to the owner at a regular intervals of time.

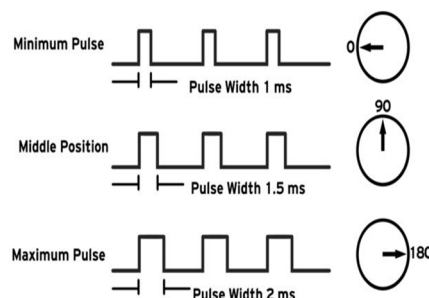
D. Picking Unit

Picking unit consists of four servomotors. When the sensors detect any metals or plastics in the soil, the servomotors rotates in its angle and pick the scrap from the field.

E. Servomotor

A servomotor is a closed-loop mechanism which uses position feedback to control the motion and final position. The input to its control is a analog signal or digital signal representing the position commanded for the output shaft.

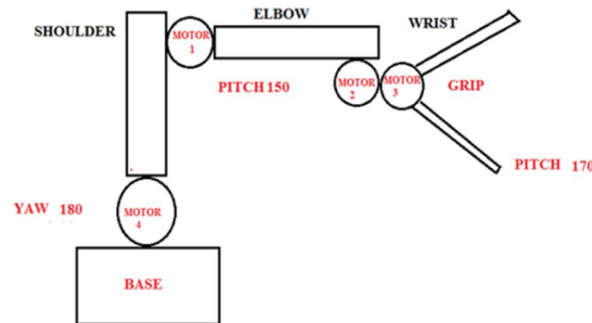
Usually, a servo arm can turn 180 degrees. Using the Arduino, we can tell a servo to go to a specified position and it will go there. The servo motor has a female connector with three pins. The darkest one is usually the ground. Connect this to the Arduino controller's GND. Connect the power cable should be red to 5V on the Arduino. Connect the remaining line on the servo connector to a digital pin on the Arduino



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It is a square wave similar to PWM. Each cycle in the signal lasts for 20 milliseconds and most of the time its value is LOW. At the beginning of each cycle, the signal is to be HIGH for the time between 1 and 2 milliseconds. At 1 millisecond it represents 0 degrees and at 2 milliseconds it represents 180 degrees. In between, it represents the value from 0–180.

F. Arm Operation



Arm is used to pick the scrap from the farm after sensing that stuff.

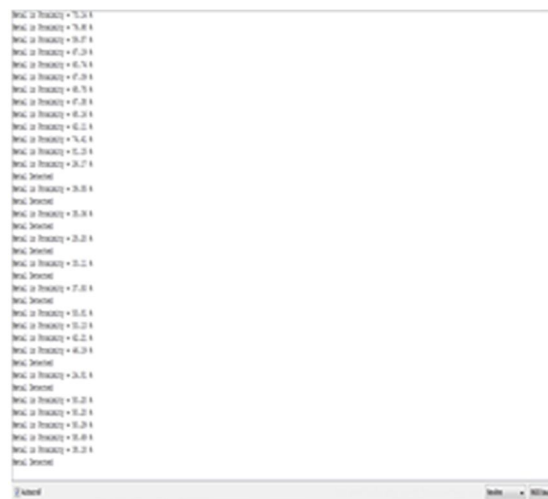
In three ways, we can move the arm

- 1) Up and Down movement –PITCH
- 2) Right and Left movement – YAW
- 3) Rotating the whole arm as screwdriver – ROLL.

III. RESULTS AND DISCUSSIONS

The results discussed are sensing the inductive and capacitive sensors. We read the analog values from these sensors using arduino mega controller. We made the servomotors rotate when the sensor senses the materials. Hence these four servomotors acts as an arm for our robot. The materials will pick up the scrap from the field and remove it from the farm autonomously.

A. Serial Monitor Output



From the sensor we get these analog output values.

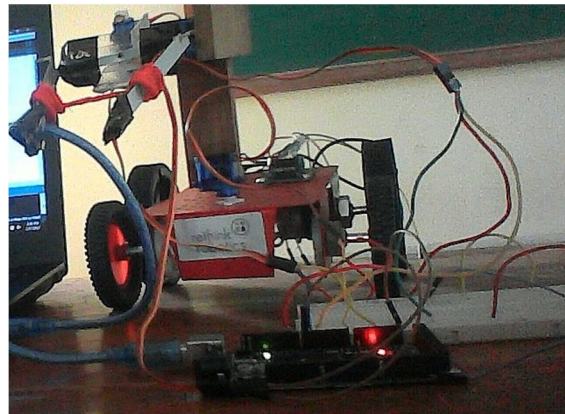
B. Pick and Place Robot

For removing unwanted scrap from the field we design pick and place robot. For pick and place robot we made a robotic arm. The robotic arm consists of four servomotors. One servomotor serves as a base. Second servo as a shoulder. Third servo as a elbow. Fourth one acts as a wrist. Yaw movement has an angle of 180°. Pitch movement has an angle of 150. Again the wrist has a pitch

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movement of 170.

Hence, so far we have done the pick and place robot for removing scrap.



IV. CONCLUSION

In this paper we have presented the autonomous robot for identifying the soil parameters and intimate the conditions to the owner. Also metal and plastics are detected and remove it from the farm.

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