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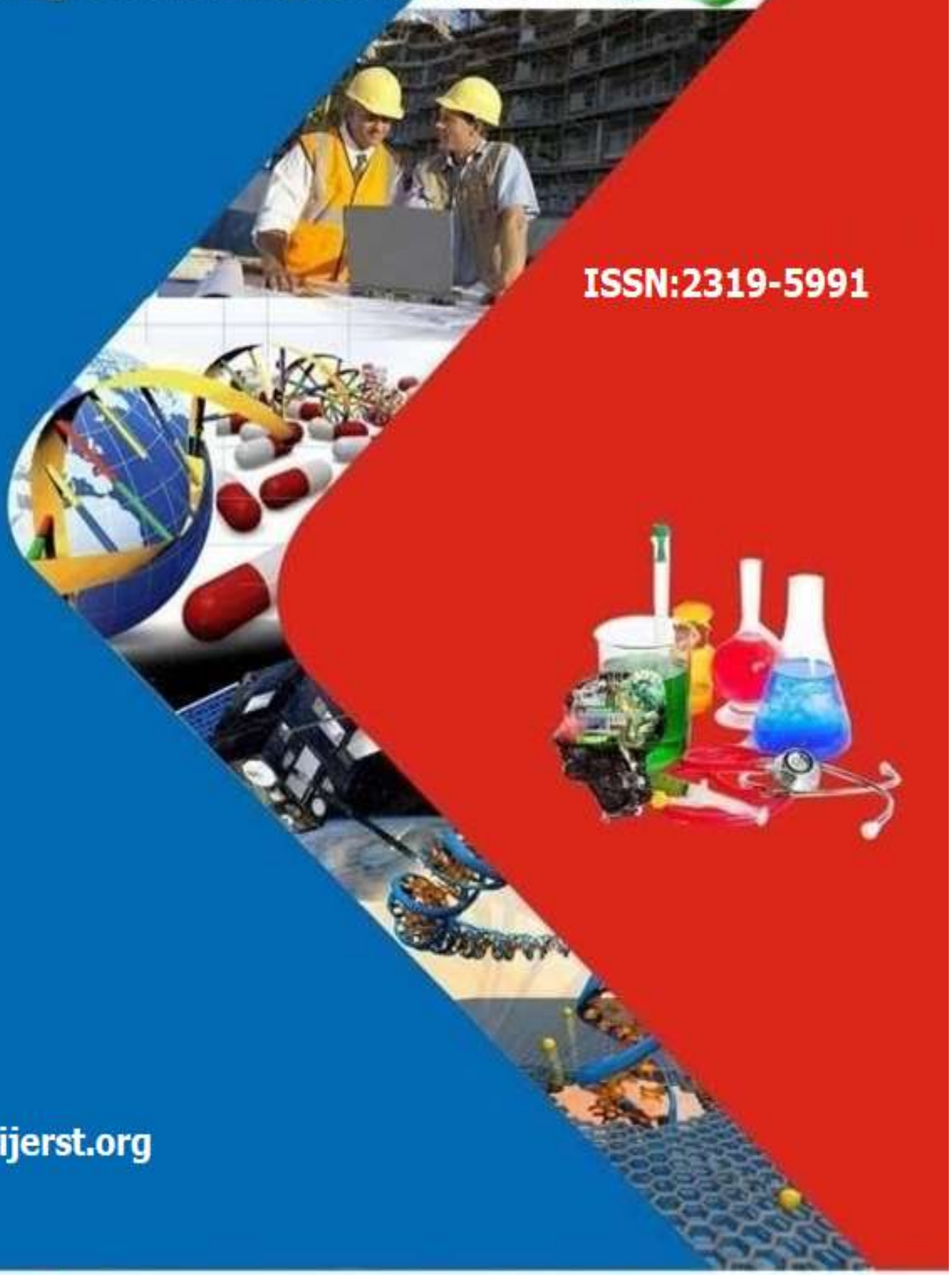

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# AN IOT BASED SMART AGRICULTURE ROBOT

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**Abstract**:- Over the past few decades, agricultural systems have encountered significant global challenges, including short-age of food supply, declining water availability, rising input costs, and diminishing agricultural labor. The advancement of Agricultural Technology (AgTech) in recent years has increased farm productivity and replaced manual monotonous tasks that are unsafe or inefficient for farm labor workers to do by hand. In this paper, we propose to develop and implement a smart agricultural robot named SARDOG that is based on the Farm-ng Amiga robot framework. LiDAR, Internet-of-Things (IoT) sensors, and a robotic arm all of which work hand in hand to perform multiple intelligent farming tasks autonomously and effectively. SARDOG is capable of autonomous GPS-less navigation using LiDAR, picking fruits using the robotic arm, testing the soil properties using a robotic actuator sensor framework, it can follow the farmers in the field and carry the produce for them among many other applications. The purpose of SARDOG is to make multiple major farming processes more efficient, cost-effective, and humane, as well as to perform some new farming processes that are not widely explored.

## 1. INTRODUCTION

### 1.1 GENERAL

Agriculture is the backbone of India. The history of Agriculture in India dates back to Indus Valley Civilization Era and even before that in some parts of Southern India. Today, India ranks second worldwide in farm output. The special vehicles play a major role in various fields such as industrial, medical, military applications etc., The special vehicle field are gradually increasing its productivity in agriculture field. Some of the major problems in the Indian agricultural are rising of input costs, availability of skilled labours, lack of water resources and crop monitoring. To overcome these problems, the automation technologies were used in agriculture. The automation in the agriculture could help farmers to reduce their efforts. The vehicles are being developed for the processes for ploughing, levelling, water spraying. We can expect the robots performing agricultural operations autonomously such as ploughing, seed sowing, mud closing and water spraying. Watching the farms day & night for an effective report, allowing farmers to reduce the environmental impact, increase precision.

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## 2. LITERATURE SURVEY

### 2.1 EXISTING SYSTEM

The current agricultural practices heavily rely on manual labor and traditional machinery, which can be inefficient, time-consuming, and costly. Farmers often face challenges such as labor shortages, inconsistent crop monitoring, and difficulty in managing large areas of farmland. Additionally, existing automated solutions are often not versatile enough to handle the diverse tasks required in modern farming, such as soil analysis, planting, watering, and pest control.

### 2.2 PROPOSED SYSTEM

The proposed Smart Agricultural Robot Bulldog (SARDOG) aims to revolutionize farming by integrating advanced robotics, and IoT technologies. SARDOG is designed to autonomously perform a variety of agricultural tasks with precision and efficiency. It will feature capabilities such as realtime soil analysis, precision planting, automated irrigation, and pest detection and control. This smart robot will not only reduce the reliance on manual labor but also enhance productivity and crop yield through data-driven decision-making and precise farming techniques.

## 3. BLOCK DIAGRAM

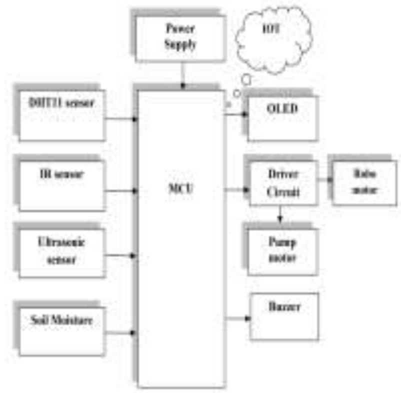


FIG: 1 Block diagram

### 3.1. HARDWARE COMPONENTS

- Regulated power supply.
- IR sensor
- DHT11 sensor
- US sensor
- Soil moisture sensor
- Micro controller.
- IOT

### 3.2. SOFTWARE REQUIREMENTS:

- MCU
- Embedded C, python

## 4. IMPLEMENTATION (WORKING PROCEDURE)

4.1 Robotic Base Platform Integration SARDOG is developed on the Farm-ng Amiga robot framework, which provides a modular and adaptable robotic base for agricultural applications. • The platform features a four-wheel electric drive system suitable for rugged farm terrain. • A modular chassis enables easy attachment of sensors, actuators, and tools. • Battery-powered operation ensures field mobility without dependency on external power sources.

4.2 LiDAR-Based Autonomous Navigation (GPS-less) To enable operation in GPS-

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denied environments such as greenhouses or remote fields: • A LiDAR sensor is used to generate 2D/3D maps of the environment. • SLAM (Simultaneous Localization and Mapping) techniques help the robot localize itself and build a map in real-time. • Advanced path planning algorithms and obstacle avoidance functions allow safe and efficient autonomous navigation.

4.3 IoT Sensor Integration for Environmental Monitoring SARDOG integrates multiple IoT sensors for smart farming insights: • Soil moisture sensors measure water content at various depths. • Temperature and humidity sensors track climatic conditions to support crop-specific needs. • Nutrient sensors (pH, NPK, salinity) provide critical data for soil health and fertilizer application.

## 5. SIMULATION AND DESIGN

5.1 System Architecture Design The architecture of SARDOG was designed using a modular approach, dividing the system into key subsystems: • Mechanical Subsystem: Includes chassis, drive motors, robotic arm, and structural frame. • Electrical Subsystem: Includes power distribution, motor drivers, sensors, and actuators. • Software Subsystem: Comprises navigation algorithms, sensor data processing, image recognition, and control logic. • Communication Subsystem: Handles data exchange between sensors, processing unit, and the cloud dashboard. A detailed block diagram illustrates the interaction among components, ensuring scalability and ease of troubleshooting.

5.2 CAD Modeling and Mechanical Design • The mechanical structure of SARDOG was modeled using SolidWorks and Fusion 360. • Design elements included: o Modular aluminum frame for lightweight durability. o Mounting brackets for sensors and the robotic arm. o Protective casings for LiDAR and IoT sensors to withstand field conditions. • Stress and thermal analysis were performed using simulation tools to verify the design under load conditions.

5.3 Kinematic and Dynamic Simulation To ensure accurate movement and control: • Kinematic modeling of the robot and the robotic arm was performed using MATLAB Simulink and Gazebo. • Forward and inverse kinematics were simulated to validate arm movement and end-effector positioning. • Dynamic simulations evaluated load handling, traction control, and turning radius on uneven terrain

## 6. CONCLUSION

The robot for agricultural purpose an Agrobot is a concept for near the performance and cost of product once optimized,will prove to be work through in the agricultural spraying operations. smart agriculture robots stand as pivotal tools revolutionizing the farming industry. With their advanced technology, these robots offer a myriad of advantages that significantly enhance agricultural practices. smart agriculture robots streamline laborintensive tasks, promoting efficiency and reducing reliance on manual labor. This not only saves time and resources but also ensures that farming operations are conducted with precision and accuracy. The data collected by smart agriculture robots provides valuable insights into crop health, yield predictions, and optimal farming practices. This data-driven approach enables

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continuous improvement and optimization of farming operations, ultimately leadingto increased productivity and profitability. Smart agriculture robots represent a transformative force in modern agriculture, offering a holistic solution to the challenges faced by farmers. By leveraging advanced technology and data-driven insights, these robots pave the way for a more sustainable, efficient, and productive future in farming.

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