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Smart Agricultural Robot

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Abstract: This paper represents technological enhancement in the field of agriculture. Agriculture is the most important part of the country's economy as it gives great contribution to the development of the country. Here we are proposing a wireless agricultural robot which will perform basic operations done in farming activities so that it will reduce the labor size, time and energy required to perform the different tasks. The concept of smart agricultural robot represents a Wi-Fi controlled robot that will perform digging mechanism, seed sowing mechanism and water irrigation after sensing the temperature and moisture of soil. Moreover, the proposed mechanism gives a solution for farmers to automate irrigation. Farmers may make decisions based on monitoring different parameters like humidity, soil moisture, temperature etc. received on his mobile app.

Keywords--- Agriculture, Robot, GPS, GSM, ARM7

I. INTRODUCTION

Few years back farmers were using bullock to perform different agricultural task, after some advancement in the technology farmers are now using tractors for seed sowing operations but still there are some tasks which need to be performed by farmers manually, so to reduce man power and efforts we are designing a smart agricultural robot which will be controlled by farmers using wireless technology, and it will perform basic farming operations. Many systems were developed in past years to provide the best solutions in a field of agriculture which results in greater yield of different crops. Nowadays technology is becoming a great contributor in this field as with its advancement systems are developed using microcontrollers to perform different tasks like surveillance, fruit picking and other operations as well. A precision agriculture robot for seeding function was being researched in which a robot was developed which helps in sowing seed to specific depth according to crop requirement [1]. A Smart Farming System Using Sensors for Agricultural Task Automation was developed which works with different sensors to predict the moisture and nutrient contents of soil and works as water irrigator [2].

A Smart farming using IOT system is being researched which works with obstacle sensor and other sensors and performs cutting and spraying functions [3]. A GPS based autonomous agricultural robot was developed which uses GPS and magnetometer and performs plowing, leveling, and gives message indications to start the irrigation process [4]. By integration of hardware and software automated devices can carry out various processes like seed sowing, irrigation, sensing of temperature, humidity and fertilization. Various Wireless networks are utilized in respect to control the action from the remote place. It may be done using GSM, Sensors network, Zigbee, Bluetooth and IOT [5-8].

Table I: Comparison table to summarize the differences with other systems

Parameters	Precision robot	Smart Farming using Sensors	Smart Agricultural robot using IOT
Microcontroller	ARM7	Ardiuno	AVR
Technology used	GSM based	IOT based	Telnet based
Working	Precise seed sowing operation	Sensing moisture and perform irrigation	Sense temperature, moisture, distance and perform basic operations
Cost	Expensive	Low cost but limited operations	Cost effective
Operations	Perform seed sowing only	Performs irrigation only	Performs irrigation seed sowing and digging.

The proposed architecture uses the Wi-Fi module to send the sensed data from sensors to farmer mobile app. Farmer can also give commands from his phone to the robot present at his fields to perform the needed activity. A summary of various parameters which are helpful in opting the solution among the present are listed in comparison Table I.
This paper will work on different parameters like temperature and soil moisture content according to crop requirement. The main objective is to build a general purpose robot that will help in performing different operations related to farming. This paper also aims at using cost-effective technology which will be affordable and easily accessible to the farmers. The paper is organized in three main subsections. Section II describes the architecture of the proposed robot. In section III the working of the proposed prototype will be discussed. Section IV will investigate the final hardware Robot and the results.

II. ARCHITECTURE OF PROPOSED ROBOT

In past years many systems were developed which were limited to performing one or two tasks like seeding, water irrigation and weeding. Those systems were based on wireless technologies like GPS which makes the system expensive and prohibitive for farmers. This paper strives at developing a system using inexpensive and lightweight components which makes it low-end and compact. The aim is to provide a cost-effective system for farmers and to reduce labor, manpower, noise and it helps in reducing pollution created by tractors these days. Fig.1 depicts the block diagram for the smart agricultural robot which senses the temperature and soil moisture of a field and performs other agricultural tasks like digging, seed sowing and water irrigation using mobile applications with the help of Wi-Fi module.

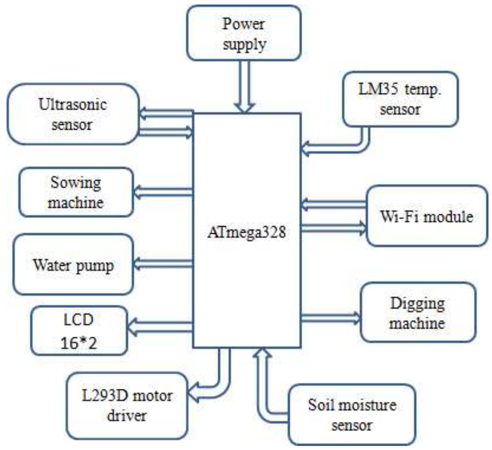

Fig.1: Block Diagram for the proposed smart agriculture system

III. METHODOLOGY

In agriculture, parameters like temperature and soil moisture are important for crop production as these parameters will detect whether a particular crop can be grown in that area or not. The temperature of field is observed using a LM35 temperature sensor, in accordance with this water content of soil is sensed by soil moisture sensor and an ultrasonic sensor is used to detect obstacle in the fields and also detects the fencing of field 50cm beforehand, all these conditions are displayed on 16×2 LCD. When conditions of field are perfect for a particular crop then user can send command to the robot using a mobile application which is connected with the Robot through a Wi-Fi module named as ESP8266, this module will receive commands from mobile application and send it to AVR microcontroller then it will send these commands to other components to perform a desired task. Fig.2 shows the screenshot of a mobile application used by the farmer to control the proposed smart agricultural robot.

Fig.2. Screenshot of Mobile application

Table II: List of Operations given on mobile app

Operations	Task performed
Forward#	Moves robot in forward direction
Backward#	Moves robot in backward direction
Right#	Moves robot in right direction
Left#	Moves robot in left direction
Sow#	Rotates the seed bottle to drop seeds
Up#	Moves digger upward
Down#	Moves digger downward
Pump on#	On water pump
Pump off#	Off water pump
Send status#	Send temperature, moisture content, distance to app
Stop#	Stops movement of robot

Table II. Elucidates the operations performed on pressing different keys on mobile applications. By a single click on the operation tab, users can control the robot at fields to perform the appropriate activity to yield the crop. The input is given to ATmega328 IC through the Wi-Fi module and output is obtained at the mechanical parts of the robot. For moving the robot forward or backward DC motors are connected with wheels which will move the robot easily on normal as well as rugged fields. For digging mechanism, a clipper is connected with the help of a dc motor which will dig soil when a command to perform digging operation is received using Wi-Fi module.

To perform seed sowing operation a bottle with holes in it is connected to the system using a DC motor so that seeds can be dropped in soil easily by rotating the bottle using a DC motor. When the user sends a command for seeding operation from a mobile application the microcontroller will receive the command and send it to the DC motor which is connected to the seed bottle and make it to drop seeds in soil. In order to make soil wet or perform water irrigation a submersible DC water pump is connected in a system which will receive command through Wi-Fi to plunge water in soil which will help in keeping moisture content of soil as required.

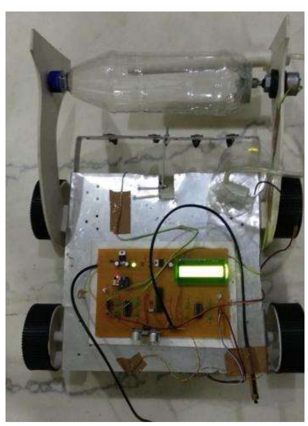

Fig.3 Final proposed prototype with LCD display

An ultrasonic sensor is added in the system which detects fencing of the field before 50cm of reaching the fencing so that when sensor detects the fencing it will stop and send message to user that obstacle is detected on mobile app of user. Fig3 shows an image of the final robot which will perform basic agricultural tasks and a LCD display to show the reading taken up while the experiment has been performed. A small piece of land is used to perform the experimental setup to test various operations as listed in Table3.

IV. RESULTS AND DISCUSSION

The main aim of developing a multipurpose system is to reduce time and energy consumed in performing agricultural tasks. This system also aims at making a cost-effective aid which can replace existing systems and help in efficient crop production.

Table 3: Calculated time delays

Operations	Task performed	Time delay
Connection power supply	Supply power to whole circuit	2-3 secs
Wi-Fi connection	Connects robot to internet	5-6 min
Movement		
Forward	Moves robot forward	2-3 secs
Backward	Moves robot backward	2-3 secs
Left	Moves robot left	2-3 secs
Right	Moves robot right	2-3 secs
Irrigation		
Pump On	On water pump	2-3 secs
Pump Off	Off water pump	2-3 secs
Sowing		
Sow	Rotates the seed bottle to drop seeds	2-3 secs
Digging		
Up	Moves digger upward	2-3 secs
Down	Moves digger downward	2-3 secs
Send status	Send parameters details to app	4-5 secs
Stop	Stops movement of robot	2-3 secs

This robot will perform basic operations of agriculture easily and it will be beneficial for farmers to get solutions to their problems in hand.

Fig.4. LCD output for the conditions of Dry soil

To check the performance of the robot, experiments are done on both dry soil and wet soil and moisture content is displayed on display for both soils.

Fig.5. LCD output for the conditions of Wet soil

When experiments were performed the time required for performing different operations have been calculated. Table 3 presents the time delays during the various operations performed. This system will perform basic agricultural tasks in a very less time and help in reducing labor and manpower.

VII. CONCLUSION AND FUTURE SCOPE

A smart agricultural robot is developed to perform basic tasks of agriculture i.e. sensing temperature, sensing moisture content of soil, digging, seed sowing and water irrigation. This robot is developed using low end and accessible components which makes it cost effective. In order to sense temperature LM35 temperature sensor is used and for observing the moisture content in soil, moisture sensor is used which helps in providing greater yield of different crops. Technology used in this system is easy to understand which makes it user friendly. In this system Wi-Fi module is used for serial communication between AVR microcontroller and mobile application which is easily accessible. The design of the robot is less complex and manageable which proves to be a quick fix to farmer’s problems. This robot helps in reducing man power, labor, cost, noise and it helps in decreasing pollution created by tractors these days. This robot can be a good choice over tractors which are being used now as it is an environment friendly system. For further advancements we can use solar panels to provide power supply to the system which makes the system less dependent on electricity because there are large amounts of power cuts in rural areas. We can also add different operations in the robot like spraying pesticides, cutting weeds etc.

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