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A Smart Agricultural Unit

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***Abstract*—This paper deals with the exposition of how robotics can be applied to various fields of agriculture. One of the most important occupations in a developing country like India is agriculture. It is very important to improve the efficiency and productivity of agriculture by replacing laborers with intelligent machines like robots using latest technologies. The paper proposes a new strategy to replace humans in various agricultural operations like detection of presence of pests, spraying of pesticides, spraying of fertilizers, etc there by providing safety to the farmers and precision agriculture. The developed system involves designing a prototype which uses simple cost effective equipments like microprocessors, wireless camera, various motors and terminal equipments which is an aid to the farmers in various crop field activities.**

***Index Terms*—Pesticide sprayer, Agriculture vehicle, Robot, Stepper motor, Solar, Maximum Power Point Tracking, Sprinkler**

I.INTRODUCTION

Agriculture in India constitutes more than 60% of the occupation. It serves to be the backbone of Indian economy. It is very important to improve the efficiency and productivity of agriculture by simultaneously providing safe cultivation of the farmers. Agriculture is a major source of occupation for our population and has great impact on the economy of our country. Currently, the population uses technology more than previous decades. Starting from irrigation, cultivation, harvest till processing of plants, the technology plays its part.The drip irrigation is one of the modern technologies used by farmers in all areas for efficient use of water for irrigation. Along with this the fertilization for plants is also taken care by the technology.
Now days, Plant disease has come to light because of significant reduction in both quality and quantity of agricultural productsOperations like spraying of pesticides, sprinkling fertilizers are very tedious.

Though spraying of pesticides has become mandatory it also proves to be a harmful procedure for the farmers. Farmers, especially when they spray pesticides, take too many precautions like wearing appropriate outfits, masks, gloves etc so that, it does not cause any harmful effects on them. Avoiding the pesticides is also not completely possible as the required outcome has to be met. So, use of robots in such cases gives the best of the solutions for these problems, along with the required productivity and efficiency. Cost effective technology using components such as PIC Micro controller for the control of agriculture robot, wireless camera to track the path of the robot, stepper motors which facilitate the robot wheels to move and joysticks to guide the robotic movement are incorporated in this agriculture robotic vehicle to make all of the above feasible. The advancement in the field of robotics has widened and the fields of its application extend from home automations to military.

Application of Robotics in the field of machinery design and accomplishments of tasks using agricultural vehicles had resulted in increased investment and research. Continuous supervision of agricultural field is possible with automatic performance of such agricultural field is possible with automatic performance of such agricultural vehicles [1]. Abilities of the agricultural vehicles can be categorized as guidance, detection, action and

mapping. The way of navigation by the vehicle is termed as guidance, extraction of environmental features is termed as detection and execution of the assigned task is termed as action and mapping the field with its features is mapping. All four categories are independent.

This paper is based on developing a robotic vehicle used in agriculture for spraying harmful pesticides. This project involves usage of PIC Microcontroller to control the movement of robot with the help of joystick (transmitter) and a receiver.

The wireless camera mounted on the top of the vehicle tracks the path taken by the robot. This cost effective robotic vehicle can improve productivity, safety in agricultural applications and meet the demand for labor.

An automatic vehicle which is used for main or secondary agricultural task is said to be a service unit[2-4]. An intelligent master-slave system between the agricultural vehicles developed a semi-autonomous agricultural vehicle (slave) to follow a leading tractor (master) with a given lateral and longitudinal offset [5]. To acquire aerial hypersprectral data, low-cost, small, lightweight hyperspectral sensor system that can be loaded onto small unmanned autonomous vehicle was developed [6]. This system works efficiently even under unstable illumination conditions. A vehicle capable of detecting obstacles on its way and adjusting its seed was developed for tree fruit orchards [7]. The methodology was based on the classification and clustering of registered 3D points as obstacles. Robots implemented with RTK-GPS sensors and Wi-Fi was devised which focused on the control of several robot with respect to a reference trajectory, which was computed off-line. In this work non-linear transformations permit to achieve a total decoupled model [8]. Process of applying chemicals can be controlled by means of wireless sensor network deployed on the field [9].

II. DESCRIPTION OF PROPOSED SYSTEM COMPONENTS

The proposed robotics model provides a facility to control the movement of agriculture vehicle by the use of a PIC microcontroller. The micro controller is programmed using Embedded C software according to the signals from the switches provided in the joystick which control the motors.

A. Power Supply

This power supply block consists of a step-down transformer, a bridge rectifier, a capacitor and a voltage regulator. Single-phase Active Current power supply from the mains is step down to a lower voltage range which is again rectified to Direct Current by using a bridge rectifier.

This rectified Direct Current is filtered and regulated to the whole circuit operating range with a capacitor and voltage regulator IC, respectively

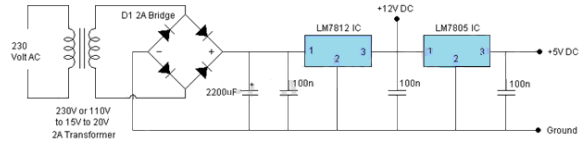

Fig.1.Power Supply

B. Microcontroller

The motherboard consists of the PIC16F87X micro controller, crystal oscillator, and filters. The PIC microcontroller is the main controller which drives the entire robot. It gives command signals to the driver circuit which drives the stepper motor to run the robot. Opto couplers are present in the motherboard; these are optically coupled and electrically isolated with the driver circuit. This protects the microcontroller and ensures that data leaves the microcontroller and no external data enters the microcontroller. It protects the controller from large back electro motive force else it may destroy the components. To program the microcontroller Embedded C is made use of. The program controls the movement of the stepper motor.

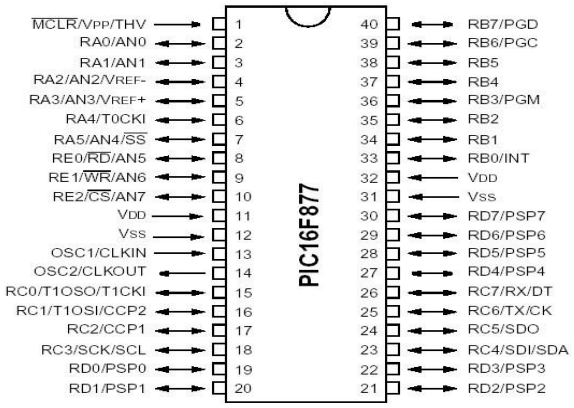

Fig.1. Pin Diagram of PIC 16F877A

The core features of the PIC16F877A include high speed flash memory, in-circuit debugging ability, low power consumption, etc [10]. The microcontroller uses the Harvard architecture and has units such as address and data buses, Arithmetic and logic unit and the registers.

C. DC motor

A DC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor. Most type produce rotary motion; a linear motor directly

This DC or direct current motor works on the principal, when a current carrying conductor is placed in a magnetic field, it experiences a torque and has a tendency to move. This is known as motoring action. If the direction of current in the wire is reversed, the direction of rotation also reverses. When magnetic field and electric field interact they produce a mechanical force, and based on that the working principle of dc motor established. The direction of rotation of a this motor is given by Fleming's left hand rule, which states that if the index finger, middle finger and thumb of your left hand are extended mutually perpendicular to each other and if the index finger represents the direction of magnetic field, middle finger indicates the direction of current, then the thumb represents the direction in which force is experienced by the shaft of the dc motor.

D. Humidity Sensor

A humidity sensor (or hygrometer) senses, measures and reports both moisture and air temperature. The ratio of moisture in the air to the highest amount of moisture at a particular air temperature is called relative humidity. Relative humidity becomes an important factor, when looking for comfort.

A sample humidity sensor Humidity sensors work by detecting changes that alter electrical currents or temperature in the air. There are three basic types of humidity sensors: capacitive, resistive and thermal. All three types of sensors monitor minute changes in the atmosphere in order to calculate the humidity in the air.

E. Robotics

The robotics plays a major role in various fields such as industrial, medical, military applications etc., The robotics 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 labors, 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 robots are being developed for the processes such as fruit picking, monitoring, irrigation, etc., All of these functions have not yet performed using a single robot. In this the robots are developed to concentrate

in an efficient manner and also it is expected to perform the operations autonomously. The proposed idea implements the robot to perform the functions such as planting, irrigation, fertilization, monitoring, and harvesting of an crop. These functions can be integrated into a single robot and then performed. The robot is expected to perform the functions such as detection of presence of pests, spraying of pesticides, spraying of fertilizers, etc there by providing safety to the farmers and precision agriculture.

III. PROPOSED SYSTEM

A major concern in many cropping systems in semi arid and arid areas. Moisture Sensor, Robo with PIC. MATLAB is given the out to Microcontroller and then it will give control to motor.LCD Display is used to display the status of the field. ROBO is used to move from one plant to another plant. This project offered stable remote access to field conditions and real-time control and monitoring of the variable-rate irrigation controller.

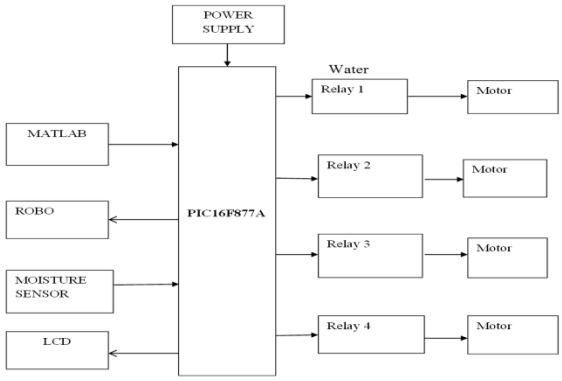

Fig.2. Block Diagram of proposed system

The sensors are inserted at the root zone of the potted plant. Initially when the power is ON, the temperature sensor senses the temperature of the soil in which the plant is grown. The sensed signals are sending to the arduino board which controls the entire process. When the temperature is above the particular level, the motor connected to this sensor starts and the relay opens the pump for watering the plant for few seconds. Next step is for sensing the moisture level of the soil which is done by soil moisture sensor. When the moisture is not in an adequate level, the motor starts again and water is let out through the pump by which further watering is done If moisture level is high, the motor stops.

Additionally, the proposed design also includes a sprinkler motor enabling spraying of pesticides, fertilizers, weedicides, etc on the crop simultaneously as the crops are being checked for pests like stem borers using the camera. This project serves to lessen the laborious work of the farmers and also proves to be very economical and efficient. The experimental setup is shown in Fig. 3. The stepper motors are fitted on the wheels which are strong enough to hold on to the wheels which are capable of moving in almost all types of terrains. The stepper motors are used as its inertia is almost zero. This is made to be a terrestrial vehicle in order to facilitate visual checking of the crops affected by pests like stem borers and for spraying of the pesticides uniformly at a specific location. Drones are not very efficient as, detection of stem-borers is almost not possible and navigation in between the crops might also lead to damage of the leaves or other parts of the crop because of the propelling fans of the drone. Since televisions are used instead of android or PC interfacing, this method is very economical and feasible for all farmers doing cultivation in both low scale and large scale.

The possibility of insufficient source voltage from the batteries might occur rarely. So in order to increase the efficacy during the working of the robot on the field, voltage level indicators are used so that indication of low supply voltage is given and this avoids interrupted functioning of robot

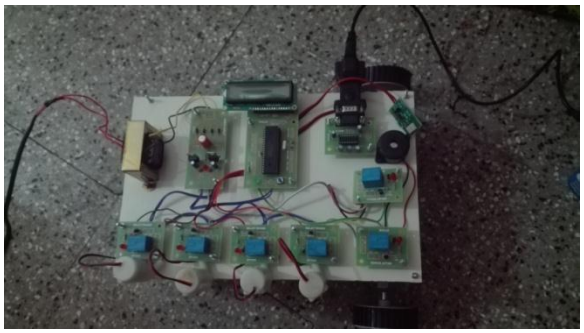

Fig. 3. Experimental setup

MATLAB is a high performance language for technical computing. It integrates computation, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include math and computation algorithm development data acquisition modeling, simulation, and prototyping data analysis, exploration, and visualization scientific and engineering graphics application development, including graphical user interface building. MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. This allows you to solve many technical computing problems, especially those with matrix and vector formulation, in a fraction of the time it would take to write a program in a scalar non interactive language such as C and FORTERN.

IV. RESULTS

This agriculture based vehicle proves to be an effective and efficient machine which can be easily navigated and controlled. The robot can move through different types of terrains and soil. Precise navigation is possible using stepper motor as it moves exactly according to the pulses received and it is inertia free, unlike a DC motor. Remote control of robot is possible through wireless camera mounted on the top of the robot and the television used as a terminal equipment to view the live images. Command for controlling the robot movement and spraying of pesticides is done by using a joy stick. Hence control of robot is user friendly and is not very complicated; hence farmers can easily control this intelligent vehicle.

Pesticide spraying is a tedious job in agriculture as it requires various protection equipments to protect the farmer. This robot mainly emphasizes on pesticide spraying by farmers from a remote location without directly coming in contact with it. This feature will encourage more people to take up agriculture as the complexity of the task is reduced and the manned task is converted to an unmanned task.

The power supply required for the vehicle is obtained using batteries. The power is obtained from the renewable source, wind energy in the working model, whereas proposal for the implementation of solar power panels for power supply is done in which the technology of Maximum Power Point Tracking is also done using incremental conductance algorithm to minimize the errors, thereby making the system very efficient, economical. Thus sustainability of the system is also achieved along with optimization of efficiency Though pesticide spraying is important to increase the production yield, unregulated usage of pesticides will damage the soil and the crops.

V. CONCLUSION

Agriculture monitoring system serves as a reliable and efficient system for monitoring agricultural parameters. The corrective action can be taken. Wireless monitoring of field not only allows user to reduce the human power, but it also allows user to see accurate changes in it. It is cheaper in cost and consumes less power. The paper was aimed at not just to extend the application of advanced technology in the field of agriculture, but also to bring the technology close to the reach of farmers in financial aspect, in a very convenient way. The paper proposes smart machinery for agriculture which promises to overcome certain challenges which lie in the present day agriculture. It encourages the use of technology to improve the productivity in agriculture. It reduces certain tedious work in agriculture and hence encourages many people to take up agriculture as an occupation. In this regard, the paper proposes an agriculture vehicle which proves to be feasible and economical to all classes of farmers who do both large scale and small scale farming. The vehicle is easy to operate and is user friendly. It also helps the farmers in hitting their target of high productivity along with secured farming.

The agricultural vehicle for spraying pesticides proposed in this paper is a collaboration of all basic feasible technologies, to bring out a new and needy vehicle to assist farmers in tasks involving risks. Projects like this encourage people to take up cultivation as full time and part time jobs. This is very essential in developing countries, especially India, where agriculture is the backbone of the economy

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