IOT Enabled Pesticide Sprayer with Security System by using Solar Energy

Amaresh A M
Assistant Professor, Department of Department of CSE, GSSSIETW Engineering College, Mysore, India.

Anagha G Rao
Department of CSE, GSSSIETW Engineering College, Mysore, India

Fenaaz Afreen
Department of CSE, GSSSIETW Engineering College, Mysore, India

Moditha N
Department of CSE, GSSSIETW Engineering College, Mysore, India.

Syeda Arshiya
Department of CSE, GSSSIETW Engineering College, Mysore, India.

***Abstract*— This paper deals with the exposition of how IoT can be applied to various fields of agriculture. Smart farming is a modern technology used to increase the quality and quantity of agricultural products. Farmers in 21st century have access to GPS, soil scanning, data management and IoT technologies. The main objective of smart farming is to ameliorate the quality of human life in terms of comfort, efficiency and productivity. The IoT allows the objects to be observed and accessed remotely across existing networks, creating right set of circumstances for more direct interaction between objects and computers resulting in enhanced efficiency , precision and economic hike. Many a times the agricultural yields are destroyed due to any intrusion by animals or rivalry, so as to limit these activities, an intrusion detection system can be installed to track the fields and keep the farmer vigilant. The sensors installed are designed to detect and measure movement. This article presents a comprehensive survey on various features like GSM based intruders, scanning, security and proper irrigation facilities, pesticide sprinkler is controlled by using an android application. The Bluetooth acts as a communicating device between the android application and the pesticide sprinkler. Various sensor nodes are deployed at different locations in the farm. These parameters are controlled using remote devices, internet services and the operations are performed by interfacing sensors, cellular data, and camera with micro controller. This project is meticulated to enhance the farmer's efforts smartly.**

Keywords—Pesticide sprinkler, agribot, IoT, wireless controller, solar.

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 for the farmers. Operations like spraying of pesticides, sprinkling of 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 as well as intruders, stepper motors which facilitate the robot wheels to move and android application incorporated with navigation buttons to guide the robotic movement are ingrained in this agriculture robotic vehicle to make all of the abovefeasible.

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 the agricultural field is possible with automatic performance of such agricultural vehicles. 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 the four categories are interdependent.

This paper is based on developing a robotic vehicle used in agriculture for spraying harmful pesticides. This project involves usage of PIC Micro controller to control the movement of robot with the help of navigation buttons and a receiver (Bluetooth Module). The wireless camera mounted tracks the path taken by the robot. This cost effective robotic vehicle can improve productivity, safety in agricultural applications and meet the demand forlabor.

An automatic vehicle which is used for main or secondary agricultural task is said to be a service unit. An intelligent master-slave system between agriculture vehicles developed a semi-autonomous agricultural vehicle (slave) to follow a leading tractor (master) with a given lateral and longitudinal offset. To acquire aerial hyper spectral data, low-cost, small, lightweight hyper spectral sensor system that can be loaded onto small unmanned autonomous vehicle was developed. This system works efficiently even under unstable illumination conditions. A vehicle capable of detecting obstacles on its way and intimates farmer regarding the intruder detected. The methodology is based

on providing security to the farm in the absence of the farmer and keeps the farmer updated about the whereabouts of the farm. Agri-Bot is implemented with GSM Module, IR sensor, Bluetooth module and pesticide sprinkler is devised which focuses on the control of Agri-Bot with respect to a reference trajectory. Process of sprinkling pesticide can be controlled by the farmer using the navigation buttons.

Meanwhile our project uses simpler components such as a PIC microcontroller, wireless camera, android application, Bluetooth, IR sensors, sprinklers and DC motor to implement a cost effective agriculture robotic vehicle for spraying pesticides thereby protecting the farmers from the harmful effects of the chemicals and provide security to the farm.

II. DESCRIPTION OF THE PROPOSEDSYSTEM COMPONENETS

The proposed robotic model provides a facility to control the movement of agriculture vehicle by the use of a SST micro controller. The micro controller is programmed using Embedded C software according to the navigation buttons provided in the android application which controls the agribot's movement.

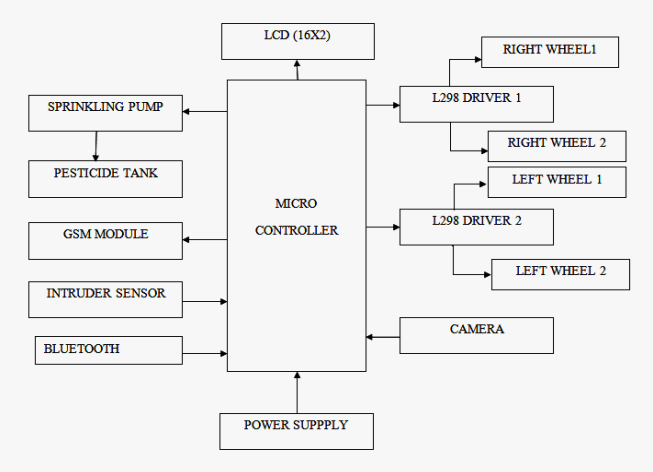

Fig. 1. System Architecture

A. *MotherBoard*

The P89V51RD2 is an 80C51 microcontroller with 64 kB Flash and 1024 bytes of data RAM. A key feature of the P89V51RD2 is its X2 mode option. The design engineer can choose to run the application with the conventional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (6 clocks per machine cycle) to achieve twice the throughput at the same clock frequency. Another way to benefit from this feature is to keep the same performance by reducing the clock frequency by half, thus dramatically reducing the EMI. The Flash program memory supports both parallel programming and in serial In-SystemProgramming(ISP).Parallelprogrammingmodeo ffersga ng-programming at high speed, reducing programming costs and time to market. ISP allows a device to be reprogrammed in the end product under software control. The capability to field/update the application firmware makes a wide range of applicationspossible. The P89V51RD2 is also In-Application Programmable (IAP), allowing the Flash program memory to be reconfigured even while the application is running. The pin diagram and the signals are shown below in Fig.2.

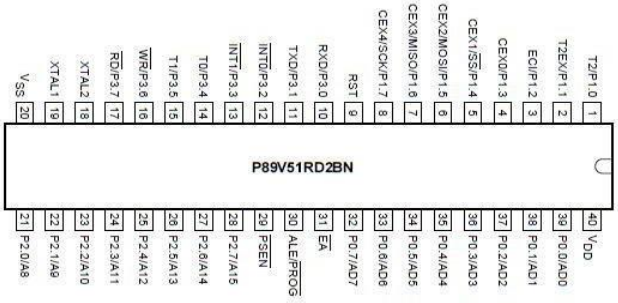

Fig. 2. PIN diagram of P89V51RD2 microcontroller

The core features of the P89V51RD2 include 80C51 Central Processing Unit, 5V operating voltage from 0 to 40 MHz, 64Kb of on chip flash memory with ISP, supports 12 clock or 6 clock mode, SPI and enhanced UART, programmable watchdog timer. The microcontroller uses the Harvard architecture and has units such as Address & data buses, ALU and Registers. The three types of registers are

- General purpose registers, which are of 8 bits and are used as staticRAM
- Working registers are also of 8 bits capacity and are used in the ALU operations.
- Special function registers are used for the control of operations of the device and are used by the CPU and the peripherals.

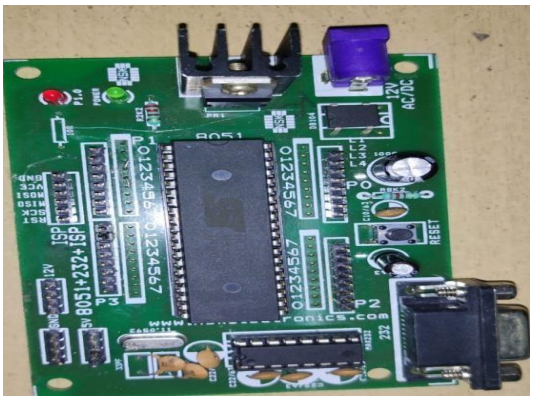

Fig. 3.8051 Development Board

B. *IR Sensor*

IR Sensor is a multipurpose infrared sensor which can be used for obstacle sensing, line sensing and so on.The sensor provides a digital output (1 or 0).The sensor outputs a logic one(+3.5V) at the digital output when an object is placed in front of the sensor and logic zero(0V), when there is no object in front of the sensor.An on board

LED is used to indicate the presence of an object.

Fig. 4. IR sensor

C. *Power Supply Board to water pump*

- Input Voltage AC 0-12
- Output Voltage +5V
- Inputs and Outputs connected to terminal blocks
- Maximum load 0.750 Amps
- This power supply is very useful for embedded applications

Fig. 5.Power supply Board

D. *Renewable Power Source(Solar)*

Power is essential to drive the entire robot. Since battery adds on to the cost, weight and battery drain proves to be a problem when a renewable power source is used. Power is produced using solar panels which drives the motor. Other renewable energy sources like wind energy can also be used for optimal power generation and utilization.

Fig. 6. Solar Panel

E. *Driver Circuit*

The Device is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads (such as relays solenoids, DC and stepping motors) and switching power transistors. We have used this driver circuit too drive the motors of the robot. Each L293D is used to drive two motors.

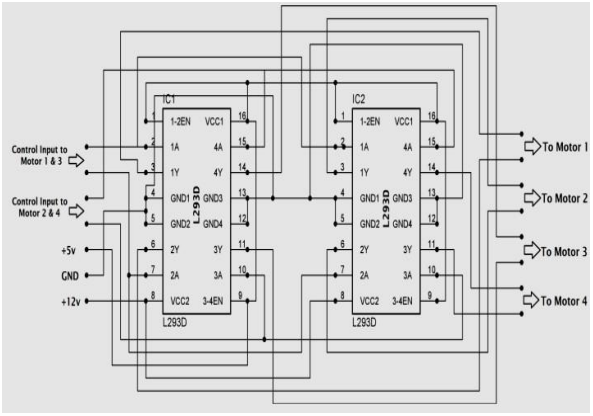

Fig. 7.Motor Driver Circuit

Two L293D's are used to drive four motors. When both the inputs are low the motor will be in the halt state, when the first input is high and the second input is low the motor will move in the forward direction, when first input is low and second input is high the motor will move in the reverse direction and when both the inputs are low the motor will be in the halt state.

NR-DC-ECO is high quality low cost DC geared motor. It contains Brass gears and steel pinions to ensure longer life and better wear and tear properties. The gears are fixed on hardened steel spindles polished to a mirror finish. These spindles rotate between bronze plates which ensures silent running. The output shaft rotates in a sintered bushing. The whole assembly is covered with a plastic ring. All the bearings are permanently lubricated and therefore require no maintenance. The motor is screwed to the gear box from inside.

Fig. 8. 12v 100 rpm DC Geared Motor

F. *SprinklerTank*

The sprinkler motors are used for spraying pesticides. A motor of high speed is used to spray pesticides at proper velocity and pressure. The farmer uses the joystick to turn on the sprinkler motor. Pre mixing of pesticides is done to achieve faster and efficient on field results. So the amount of pesticides sprayed can be efficiently controlled. Specific spraying of pesticides at needed location is possible as the control of the motor is in the farmer's hands. Various new technologies can be used to improve the efficiency and control of sprayingrates.

Fig. 9. Sprinkler tank

G. Buzzer

A buzzer or beeper is an audio signaling device. It may be mechanical, electromechanical, or piezoelectric (piezo for short).Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.A buzzer is a device which makes a buzzing or beeping noise. More complex buzzers include the oscillator circuit and the piezoelectric element or speaker in a single package, so all you need to do is apply a voltage and you will get an annoying beeping or buzzing sound.

Fig. 10. Buzzer

III. PROPOSED SYSTEM

This paper is based on the implementation of an agriculture robot vehicle which navigates in between the crops based on the instructions given by the farmer using android application. This vehicle uses cheaper components, so that the vehicle becomes cost effective. The farmer can use any android smart phone for this application to move the robot and track any intruder if detected in the field. Farmer will receive a picture of his farm when an intruder is detected. He will obtain a message or notificationfrom Agribot about the event occurred in the farm.

Farmer can control pesticide sprinkling device through IOT application. The robot, as it is placed in the field captures the image of the intruder, provides a way to view the crops or path of the robot using wireless camera. The signal is received at the operating end and viewed using mobile. Thus identification of the intruder is made very much possible and simple as well, the image and sends it to the farmer.

IV. METHODOLOGY

The robot is placed in the farm and is switched on through IoT and its direction is controlled by Android application. The spraying of pesticides, which can be done with the help of pesticide sprinkling pump,this can be periodically sprayed whenever the relay switch is on. The system focuses on the design, development and the fabrication of the agricultural robot with pesticide spraying system in addition to security system using IOT. The agricultural robot is used to control the function like pesticide spraying and controlled through Bluetooth module which will communicate between android application and robot with low budget. The system is provided with dc motors for moving the robot and an intruder detection sensor, whenever the intruder is detected then a message is sent to thefarmer, if the farmer's smart phone is in silent mode then a voice announcement is played about the event occurred at the farm. The farmer can take the photo of the intruder using IOT technology and view the farm.

V. FEATURES, APPLICATIONS, FUTURE ENHANCEMENT OF PROPOSED SYSTEM

Features:

- Compact and low cost.
- Number of parameters we can display on LCD.
- Fast operation because RISC architecture embedded chip is used.
- It covers 50 m of distance.

Applications:

- Used in farms and fields.
- Used in Hardware Industries and Business Units.
- Used for gardening.
- Maintain public properties and parks.
- Can as well be used in Automobile industries to spray paint.
- This Agribot can be a multi-functional device used in current scenario of Covid-19 situation for sanitizing the affected areas using Wi-Fi and Bluetooth without personal contact.
- Provides Agricultural security.

Future Enhancement:

- Autonomous agri-copters can be built to grab and analyze data of the farming field and to do pre-defined tasks autonomously.
- Additional usage of renewable resources can also help in cutting down of more battery usage, for instance, Wind energy.
- Usage of voice controlled navigation for robotic movements
- To enhance the performance of IoT based smart agriculture systems, modern technologies such as AI, ML can be incorporated into the system.
- AI-based autonomous robots can be built specially to serve the purposes of farming. The robot should be capable of analyzing data that are grabbed from sensors and make necessary decisions to serve the purposes for which it is designed.
- ML can be applied to video analysis for observing the conditions of crops such as analysis of the condition of the leaf to determine whether it is

attacked by the pests or not and lead the system to perform required action.

VI. DRAWBACKS OF EXISTING SYSTEM

There are few drawbacks of existing system which are described below:

- Maintenance– If the farming field is larger in area, spraying pesticides manually is a challenging task for a farmer.
- Labour issues – Agriculture is seasonal occupation, the laborers are weak and illiterate. Finding a laborer is a daunting task as agriculture requires more physical work.
- Sparse use of modern technology–Lack of up-gradation into modern tools and technology, usage of renewable resources.
- Monitoring– Intruder activity goes unnoticed by the farmer leading to less security in the farm.
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VII. DESCRIPTION OF WORKING MODEL

The below images depicts the working model of this project along with the components of the Agribot.

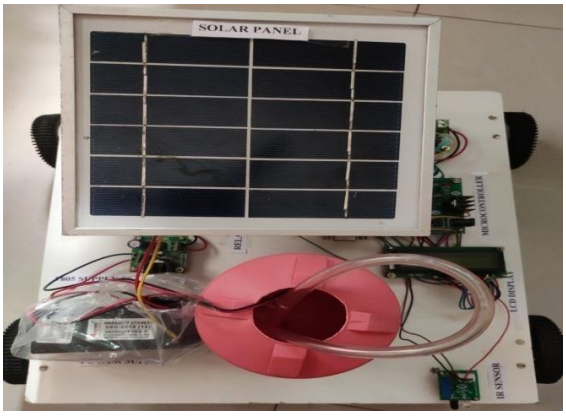

Fig. 11. Agribot

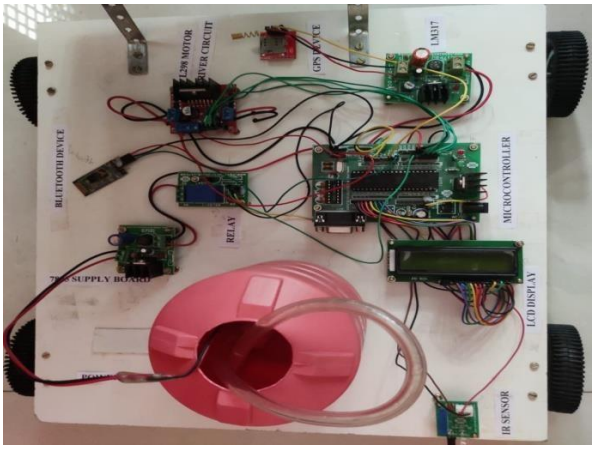

Fig. 12. Working Model along with Components

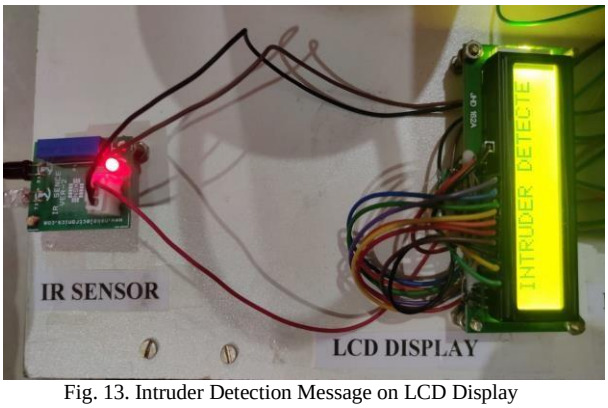

Fig. 13. Intruder Detection Message on LCD Display

The below images depicts the android application of this project used to control the functions of the Agribot.

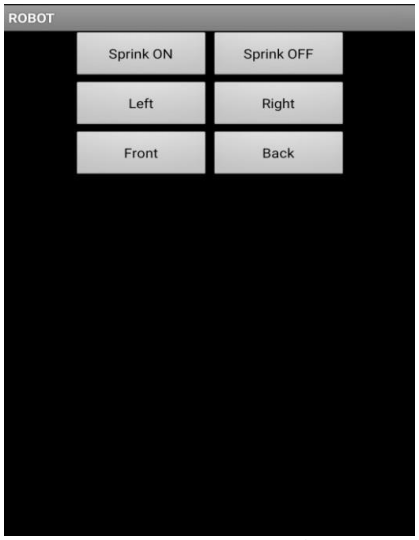

Fig. 14. Depicts the navigation controls of the robot and sprinkling controls in the application screen.

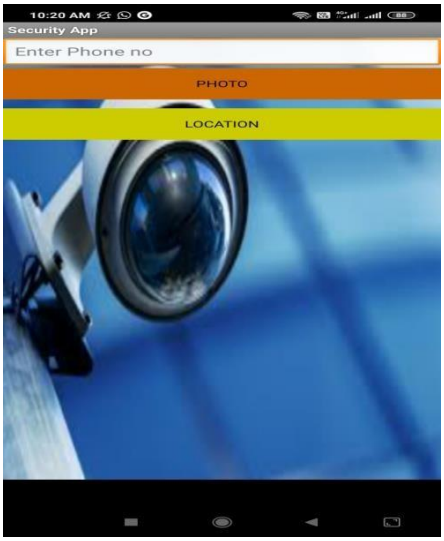

Fig. 15. Displays the security app where the location of the robot and picture of the intruder will be sent to the Farmer's phone number.

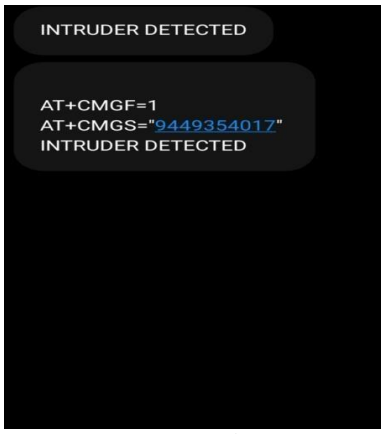

Fig. 16. Depicts the message recieved from the agribot when an intruder is detected in the farm

CONCLUSION

'Internet of Things' is far and wide castoff in relating devices and gathering statistics. This agriculture monitoring system serves as a reliable and efficient system and corrective action can be taken. Wireless monitoring of field reduces the humanpoweranditalsoallowsusertoidentify intruders causing trouble in the field. It is cheaper in cost and consumeslesspower.Thesmartagriculturesystem has been designed and synthesized. The developed system is more efficient and beneficial for farmers. It gives the information about the intruders in agricultural field through an alert messagetothefarmer,if the android phone is silent or is in vibrate mode, a voice alert message is sent announcing the nuisance caused in the field to the farmer. The system can be used in the current scenario of covid-19 to sprinkle sanitizing chemicals over the city without manual intervention. The application of such system in the field can definitely help to protect crops from intruders. In this project, IoT controlled robot, named, Agribot has been designed, built and demonstrated to carry out spraying pesticides in an agriculture field. The agribot will assist the farmers in increasing crop yielded and protect them from harmful chemicals of pesticides with security alert system.The method applied to build solar powered pesticide pumping using IOT is cost effective. It can be easily managed using android application which is user-friendly. Advanced and powerful MCU can be used to make the farming system more effective, efficient and precise. Usage of renewable resources like solar energy can help in cutting down of more batteryusage. Reduces physical work by spraying pesticides and protects the farmer from harmful chemicals. Provides security in the farm by detecting the intruder capturing the picture and sends an alert message to the farmer. This agribot is cost efficient and saves time for the farmer.

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