IOT Controlled Automated Solar Charging Agricultural Spray Electric Vehicle

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Abstract — India is an agriculture-based country so work on control of pests in the field is an important factor for crop management and yield. In order to increase the efficiency, effectiveness and to reduce the manual involvement of spraying mechanism, an automated electrically operated sprayer system is needed. Considering the continuous unavailability of electricity in remote areas of agricultural field, this paper proposes a remotely controlled pesticide sprayer which utilizes solar energy as a power source. A battery driven electric vehicle cart is designed and has mobile control through a Blink IOT module which is used to monitor different parameters and operations of this electric sprayer. All the processes and operations of this spray system are remotely controlled successfully and operated with the help of BLDC and PMDC motors powered by solar charged batteries making the designed system more cost effective and useful. This e-cart and sprayer system is used and tested for proposed applications. This system helps to reduce required manpower and makes the spraying fast.

Keywords: IOT Vehicle Control System, Solar Charging System, Multi Nozzle Spray Machine, Electric Vehicle, Monitoring System, Eco-Friendly, Easy Handling

I. INTRODUCTION

As we know India is agriculture-based country the 70% of nation GDP is from agriculture sector. So good crop yield depends on control of pesticides spraying and proper fertilizer supply. Farming requires a large human power and labours. For time & cost-efficient production, use of modern technology is essential. Traditional pesticide sprayers are either hand operated or petrol engine. In petrol engine spray pump the efficiency of that petrol engine is reduced with respect to time and also these engines emit CO2 gas into the atmospheric in a higher amount and harm the environment after some time the engine is not able to work and it will be dead. The traditional spray pump has to carry on back of farmer. The additional cost of petrol is also required. It is very time consuming. Use of solar electric powered pumps will reduce electricity, fuel cost and pollution. It works will be fast. Remotely auto controlled helps to reduce manual work, human labour's, effective and fast spraying. No need to carry pump and pesticides load by farmer. So, we proposed to design a solar powered e-cart vehicle to carry, spray pesticide with remote control access to farmer through blink IOT application.

II. PROBLEM STATEMENT

1) In operation of Traditional spray pump more human hard work is required and to reduce farmer hard work and for efficient work we make this IOT controlled spray electric vehicle.
2) At the time of spraying the farmer should have to carry the heavy pump on his Sholder.
3) The traditional spry pump is consuming the fossil fuel and it emit the CO2 and harm to the environment.
4) The additional fuel cost is needed for working of traditional spray pump.
5) The traditional spray pump required more operational time. And it is very uneasiness for farmer

III. OBJECTIVES

1) To give farmers more easy working environment while spraying because they don't need to lift or carry the poisonous tank and don't need to bend their back.
2) Design solar powered e-cart to carry all load and spray system.
3) To give continues monitor of spray level in reservoir, battery charging amount and control of spray motor to farmer
4) We also make it ecofriendly and low running cost by using solar to run the e-cart.
5) To design an ecofriendly, low maintenance cost, no fuel cost, easy operational control system for farmer.

IV. METHODOLOGY

Initially the required control and operational parameters of the propose spraying E- cart was studded and fixed on a supporting metal frame work of E-cart, the vehicle was assembled in the work shop. Motor and spray reservoir tank was mounted on the metallic frame with the help of fix supports. The motor and circuit's where designed and assembled as per requirement as shown in fig. 7.1. The designed power flow of the system is as shown in fig. 7.2. The manual and control step process of whole spray system is shown in fig. 6.1, 6.2 respectively the monitoring system of pesticide level of reservoir and battery charging percentage is design to function as shown in fig. 6.3 respectively.

V. MANUFACTURING

A. Frame –

Frame is a supporting base of E-card and subjected to static and dynamic load it also takes various loads like vertical load rider load and luggage load various accessories and components are mounted over the frame. A frame should

have sufficient strength to stand against all the listed loads. We have selected modified frame design of RC car as it fulfils the whole criterion and is designed by experts for better safety and efficiency. In order to accommodate the motor batteries and other systems some modifications are made.

B. Drive Assembly –

A rear tyre is to be driven with a chain and sprocket mechanism. In order to achieve this and hold the back wheels shaft in position, a pillown ball bearing was required. We have attached the disk brake and sprocket of cycle on shaft. A chain is used to transmit force from front sprocket on the motor shaft to the rear wheel sprocket. Ball bearings of 25mm were fitted on frame with the help of nut bolt to accommodate the rear excel. It has the following specification

– Ratio - 1:2.5 rotation

C. Pillown Bearing -

Pillown bearing are used for smooth rotation of rare wheel axial and in order to achieve the wheels in position and hold the axis a pillow bearing is used. It has the following specification

– Size – 25 mm

D. Brake System –

We have attached the disk brake system for quick stopping. The brake system is work mechanically as well as electronically when the brake is operated the motor get cut off automatically and vehicle get stop immediately. It has following specification

– Disk size - 150 mm

E. Differential Mechanism –

The differential mechanism is used for better and effective turning of e-cart.

By use of the differential mechanism e-cart gets turned easily in small space. It reduces the tyre friction.

F. Batteries –

To run the motor at full speed condition and to cover maximum range in at the designated speed motor requires consistent power supply which is easily available through batteries can be reused. We have selected lead Acid E-Bike batteries to provide the power. The voltage provided should be equal to or more than the input voltage of motor i.e. 48V DC. We have selected 4 batteries of 12V and connected them in series to achieve the required voltage. The batteries are easily rechargeable and maintenance free. Selected batteries have following specifications.

– Current rating: 18 Ah
– Voltage: 12 Volt
– Number of batteries: 4
– Combination of batteries: Series
– Combined Voltage: 48 Volt

G. Back Wheel Running Motor –

To drive the vehicle at a speed of 30 kmph and provide a rated torque about 15 N.m. we have selected motor of 750 watt. We have taken a Brushless DC motor of custom manufacturing. The motor used in this project is BLDC motor and can be custom-made as per the requirement or is available in the market. Cost of BLDC motor is below 7000, making it suitable for low-cost application. The front sprocket is attached to the shaft of the motor with the help of a mild steel pulley machined as per the requirement. With the help of a base plate motor was mounted on the centre of frame. Specification of selected motor.

– Type: Brushless DC Motor
– Rated Output Power: 750 Watt
– Rated Voltage: 48 V DC
– Rated Torque: 15.36 N.m
– Rated Speed: 2800 RPM

H. Motor Controller –

Motor power is from batteries corresponding to the input from throttle. Controller takes input from throttle connector and varies the power supply to the motor. We have selected controller suitable to our motor as per the current needs and it has the following specification.

– Operating current: 35 A
– Operating Voltage: 48 V DC
– Power: 800 W

I. Battery Charger -

Battery gets drained after running a distance of 20-30 km and it does require a recharge. For charging, a charger is required. It converts AC current into DC. It consists of a step-down transformer, a rectifier and a filtering circuit to supply constant voltage. Specifications of 48V battery charger are

– Input voltage: 170-300V
– Output voltage: DC 48 V
– Output current: 4 A
– Specification of 12V battery charger
– Input voltage: 110 to 265 Volt AC
– Output voltage: 12V DC
– Output current: 7 Ampere

J. Front Wheel Turning Motor –

To turn on the vehicle, at provided rated torque about 15 N.m. So, we have selected motor of 350 watts. A permanent magnet DC motor of custom manufacturing. PMDC Motor can be custom made as per the requirement or it is available in the market. Cost of PMDC motor below 5000 marketing is suitable for low-cost application. The front sprocket is attached to the handle shaft and the motor with help of chain sprocket mechanized as per the requirement. The motor was mounted on the front point of the vehicle chassis with the help of base plate. Specification of selected motor are

– Type: Permanent Magnet DC Motor
– Rated Output Power: 350 W
– Rated Voltage: 24V DC
– Rated Speed: 300 RPM

K. Motor Controller –

To control and monitor motor speed, motion of handle and to ensure smooth functioning of motor at rated current the motor controller is used. To control right-left motion of the vehicle through motor the controller is essential. It also provides multiple functions like power lock, light connection, charging connection etc. It has the following specifications.

– Compatible for Motor MY1020 500W

- Body Material Aluminium
- Cable Length (cm) 10
- Current Limit (A) 33
- Rated Voltage(V) 24 v DC
- Under-Voltage Protection (V) 20 V
- Weight (gm) 215
- Dimensions in mm (LxWxH) 83 x 70 x 38
- Rated Power (W) 500

L. Solar Panel –

Solar panels are sometimes it also called photovoltaics. It collects energy from the sun in the form of sunlight and converts into electricity which can be used for power supply. These panels can be used to provide power at remote locations where the electricity is not available. This system is designed to be powered by batteries which are also charged by the solar panel of 100 Watts. It makes it ecofriendly and low running cost. Specification of selected solar panel are

- Output voltage: 17 Volt
- Output current: 6 Ampere
- Watts: 100 Watt

M. DC TO DC Booster -

To charge the 48 Volt battery by using solar panel the DC-to-DC Booster is used in this project model. It steps up the 12 Volt Supply from solar panel to the 48 Volt it also has the facility to adjust the output voltage up to 90 Volt so it can easily charge the batteries of 48 Volt's. Specification of selected booster

- Rating: 1200 Watt's
- Current rating: 20 Ampere
- Input Voltage: 60 Volt
- Output Voltage: 90 Volt
- Input low Battery Protection: 9-50 Volt

N. DC Spray Pump –

The DC pump motor is used for spray the pesticide Chemical, water in agriculture, horticulture sector. Specification of Pump are

- Pressure: 110 PSI
- Required Voltage: 12 Volt
- Current Rating: 4 Ampere
- Flow: 4.5 LPM
- Quantity Used: 2

O. Nozzle ROD –

The rod having three nozzle is used to spray equally and effectively the pesticide chemical, water in farms. Specification of selected Nozzle are

- Nozzle: 3
- Quantity Used: 2

P. Hand Spry Gun -

The hand spry gun is used for better and adjustable flow of liquid.

Q. Pesticide Reservoir –

The plastic water tank is used as reservoir of pesticide for spray system It has the following specifications

- Capacity - 40 Liter's
- Material – Plastic Build

R. ESP-Wroom-32 WIFI Bluetooth Networking Smart Component Development Board – 30 PINS –

The ESP WROOM 32 MCU Module is shown. The ESP WROOM 32 is a powerful, all-purpose WiFi-BT-BLE MCU module that can handle a broad range of functions, including speech encoding, music streaming, and MP3 decoding, as well as low-power sensor networks. The ESP32S chip, which is intended to be scalable and adaptable, lies at the heart of this module. The clock frequency of the two CPU cores, which can be adjusted from 80 MHz to 240 MHz, may each be separately controlled or powered. The CPU can be turned off if the user prefers, and the low-power coprocessor can be used to continuously check the peripherals for changes or the crossing of thresholds. Capacitive touch sensors, Hall sensors, low-noise sensing amplifiers, an SD card interface, Ethernet, high-speed SDIO/SPI, UART, and I2C are just a few of the peripherals that are integrated within the ESP32S.

Features -

1) 520 KB integrated SRAM.
2) Wi-Fi and Bluetooth hybrid.
3) high degree of fusion.
4) handling of extremely little power.
5) Flash 4 MB.
6) PCB antenna on the board
7) 30pin

S. Channels 5-Volt Relay Module 30 Amp with Optocoupler Isolation Supports High And Low Triger with Guide Rail –

This is a 2-Channel Relay Module High/Low-Level Triggering Optocoupler Isolation Load 30A DC 5V / AC 250V for PLC Automation. It uses a high-power relay, the maximum control load DC 5V 30A / AC 250V 30A. In line with international safety standards, the control area and the load area with isolation slot. It comes with each optocoupler isolation, anti-interference ability.

Features -

1) Using high-power relay, the maximum control load DC 5V 30A / AC 250V 30A;
2) With each optocoupler isolation, anti-interference ability.
3) In line with international safety standards, the control area and the load area with isolation slot.
4) Each channel has a relay on the LED indication.
5) Product Applications: PLC automation equipment control, industrial system control, logistics network control, home intelligent product control, electronic enthusiasts to develop experiments, all kinds of circuit modification.

Specification -

1) Supply Voltage: DC 5V
2) Quiescent Current: 5mA
3) Maximum Operating Current: 190mA
4) Trigger Mode: High and low-level trigger
5) Load Voltage: DC 30V / AC250
6) Load Current: 30A
7) Relay Life: more than 100,000 times

T. Volt 10-AMP Signal Channel Relay Module –

This 1 channel with 5V 10A relay control board module with optocoupler modules is compliant with international safety standards, control and load areas isolation trenches it has a single relay a genuine. The inputs of 5V 10A 1-Channel Relay are isolated to protect any delicate control circuitry. The power supply and relay instructions, lit, a disconnect are off. The input signal, signal, common Terminal and start conducting. It can be used as a single chip module for appliance control and work with both DC and AC signals where you can control the 220V AC load. *A wide range of microcontrollers such as Arduino, AVR, PIC, ARM and so on can control 1 channel 5V 10A Relay Control Board Module with Optocoupler.*

Note: On the high level and low level-triggered mode

- High-level trigger refers to the signal voltage between input and trigger, can be understood as a signal input with VCC cathode short-circuit triggered a way;
- Low-level trigger refers to the signal voltage between the input terminal and Earth OV trigger, can be understood as a signal input terminal and the GND negative electrode short circuit triggered is a way 1-channel relay module connection.

Features -

1) High impedance controller pin
2) Pull-down circuit for the avoidance of malfunction
3) One normally closed contact and one normally open contact
4) Triode drive, increasing relay coil
5) Power supply indicator lamp
6) Control indicator lamp
7) With 4 fixed screw holes, hole diameter 3.1mm, convenient installation, and fixation

U. XL6009 DC – DC Step-Up Converter Performance Ultra Lm2577 Booster Circuit Board –

This XL6009 DC-DC Step-Up Converter Performance Ultra LM2577 Booster Circuit Board is a non-isolated step-up (boost) voltage converter featuring adjustable output voltage and high efficiency. The module uses the second generation of high-frequency switching technology XL6009E1 core chip performance than the first-generation technology LM2577. XL6009 boost module at a lower cost, superior performance. It equips 4A high-efficiency MOSFET switches, so as to provide a conversion efficiency of up to 94%. High switching frequency 400KHz, a small-capacity filter capacitors that can achieve very good results, the ripple is smaller and smaller.

Features -

1) The performance is much higher than LM2577.
2) Non-isolated Boost converter.
3) It has a non-synchronous rectifier.
4) Small and Handy voltage regulator module.

V. CJMCU MCP4725I2C DAC Breakout Development Board –

With CJMCU MCP4725 I2C DAC Breakout Development Board Module has MCP4725 which is an I^2C controlled Digital-to-Analog converter (DAC). A very cost-efficient option of DAC allows to send an analogy signal, such as a sine wave, from a digital source, such as the I^2C interface on the Arduino microcontroller. Digital to analogy converter is great for sound generation, musical instruments, and many other creative projects! This version of the MCP4725 Breakout came up with few fixes for an issue with the board including the IC footprint, the I^2C pinout, changes the overall board dimensions to better fit projects, and a few more minor tweaks than its previous required versions. This board breaks out each pin needed to access and use the MCP4725 including GND and Signal OUT pins for connecting to an oscilloscope or any other device to hook up to the board. Additionally, the module has onboard SCL, SDA, VCC, and another GND for basic I^2C pinout. The pull-up resistors on this board can be disabled as per the Hookup Guide in the *Documents* section below for instructions and tips.

Features -

1) 12-bit resolution
2) I^2C Interface (Standard, Fast, and High-Speed supported)
3) Small package
4) 2.7V to 5.5V supply
5) Internal EEPROM to store settings
6) Mounting hole diameter: 2.5mm
7) Distance between mounting hole: 11.5mm

W. Limit Switch –

3 terminals, applicable to AC-DC control circuits is designed to control the movement of a mechanical part. Typically utilized in industrial control applications to automatically monitor and indicate whether the travel limits of a particular device have been exceeded. A high precision mechanism design offers acute operation and long life. In snap action contacts, the movement of the actuator applies force to an over centre mechanism. This mechanism creates a quick change in contact state when the trip point is reached. Reversing the motion of the actuator to a given reset point causes the contacts to snap back to their original position. Snap action contacts have different trip and reset points. The distance between the trip and reset point is called the travel to reset, hysteresis, or differential. Finite travel to reset helps to avoid multiple changes of state if the object actuating the switch is subject to vibration. Snap action contacts ensure repeatable performance in applications that involve low speed actuators. The amount of travel of the contacts is also not dependent on the amount of travel by the actuator. Specifications are

Operation Mode	Automatic
Current Rating	15 Amps
Operating Voltage	125 Volts (AC)
Contact Type	Spdt
Connector Type	Screws
Terminal	Spdt
Item Dimensions LxWxH	2.36 x 1.57 x 0.79 inches (6 x 4 x 2 cm)
Actuator Type	hinge,long hinge
International Protection Rating	IP54
Product Dimensions	2.36 x 1.57 x 0.79 inches (6 x 4 x 2 cm); 0.01 ounces (0.28 grams)

Table 1:

X. Ultrasonic Sensor HCSR-04 –

This HC-SR04-Ultrasonic Range Finder is a very popular sensor that is found in many applications where it requires measuring distance and detecting objects. The module has two eyes like sensor in the front which forms the Ultrasonic transmitter and Receiver. The HC-SR04 ultrasonic sensor uses sonar to determine the distance to an object like bats or dolphins do. This Ultrasonic Sensor module has a transmitter, a receiver, and a control circuit in one single pack handy with compact construction. It offers excellent range accuracy and stable readings in an easy-to-use package. Its operation is not affected by sunlight or black material like Sharp rangefinders are (although acoustically soft materials like cloth can be difficult to detect). The Trigger and the Echo pins are the I/O pins of this module and hence they can be connected to the I/O pins of the microcontroller/Arduino. When the receiver detects the return wave the Echo pin goes high for a particular amount of time which will be equal to the time taken for the wave to return back to the sensor. Ultrasonic Ranging Module HC-SR04 provides 2cm-400cm non-contact distance sensing capabilities, Ranging accuracy up to 3mm.

Features -

1) Measures the distance within a wide range of 2cm to 400cm
2) Stable performance
3) Accurate distance measurement
4) High-density
5) Small blind distance

VI. ALGORITHM

A. Manual Operation -

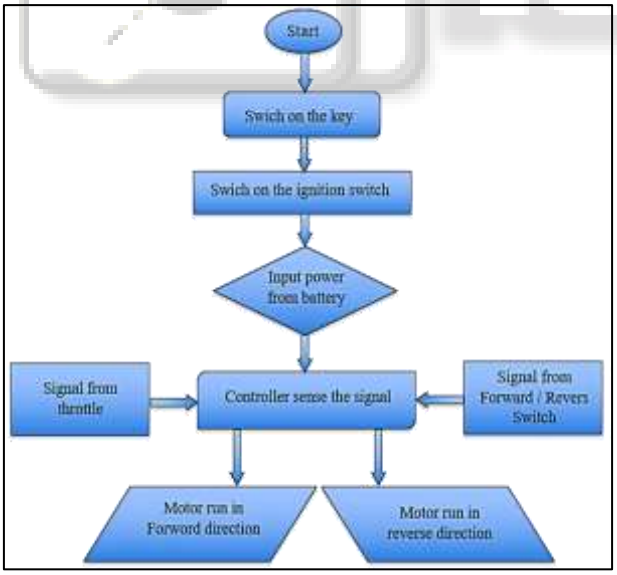

Fig 6.1: Manul operation

B. Remote Operation –

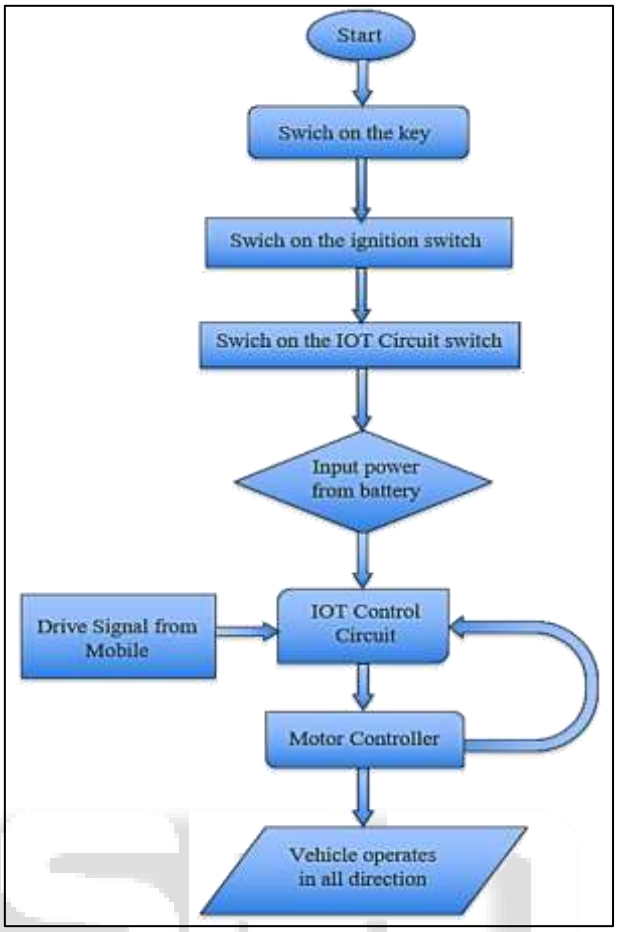

Fig 6.2: Remote Operation

C. Monitoring –

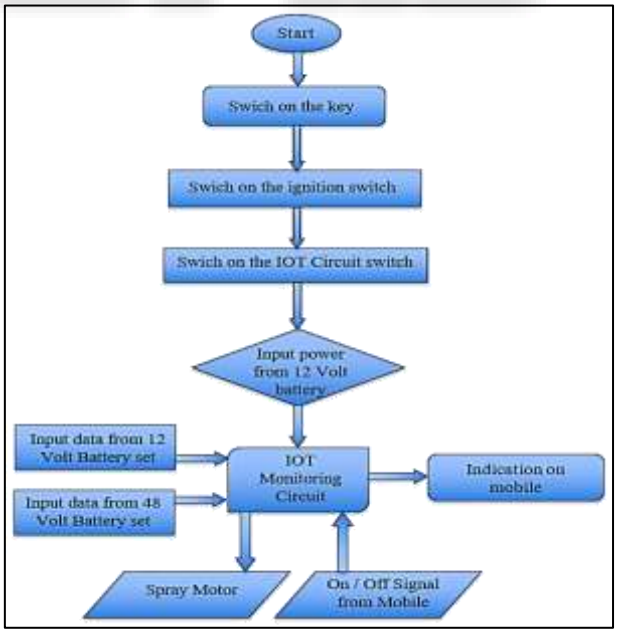

Fig 6.3: Monitoring

VII. SYSTEM DEVELOPMENT

1) Block Diagram –

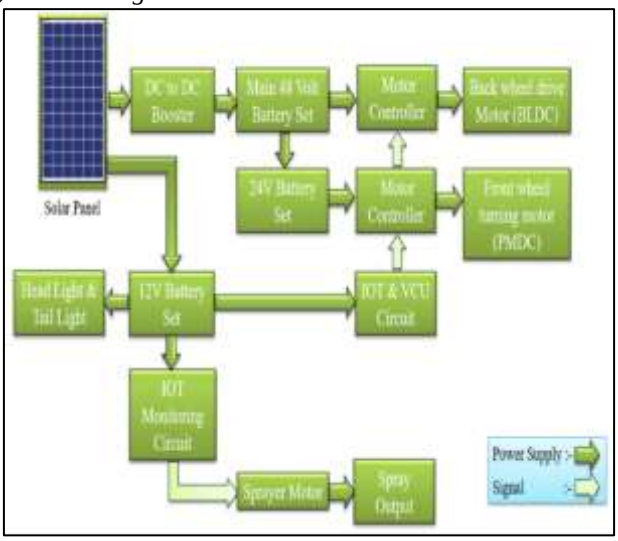

Fig. 7.1: System Block Diagram

B. Power Flow Diagram –

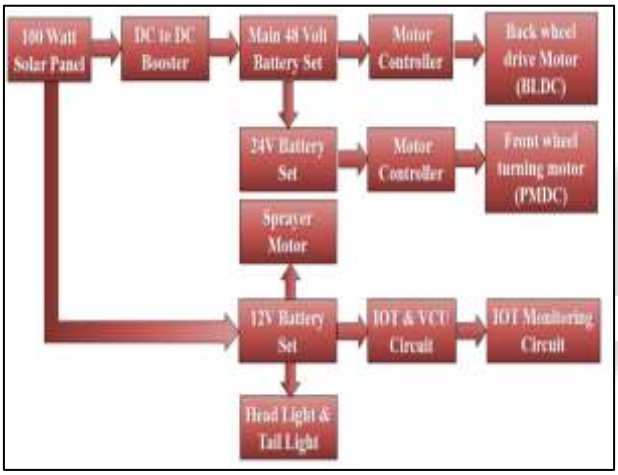

Fig. 7.2: System Power Flow Diagram

C. Control Unit Circuit Diagram -

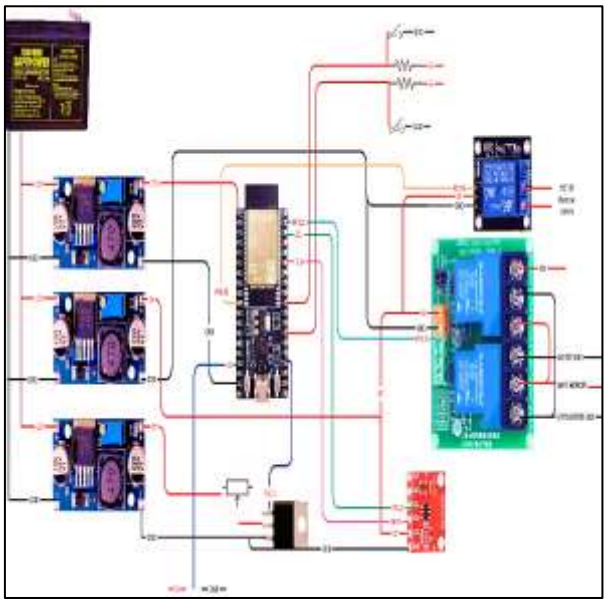

Fig. 7.3: Control Circuit Diagram

D. Visual Interface Of Control's System –

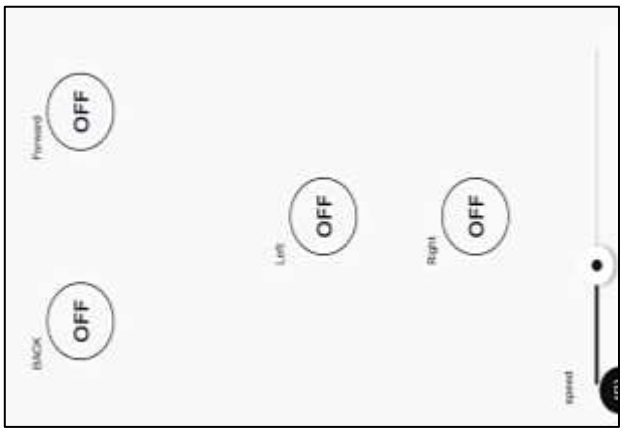

Fig. 7.4: Visual Interface of Controls

E. Control Circuit Code -

```
#define BLYNK_TEMPLATE_ID "TMPL32FOhVEwe"
#define BLYNK_TEMPLATE_NAME "Drive"
#define BLYNK_AUTH_TOKEN "v0cng0WkSebVM5mJdv_RT5J7Sj_4YqtR"
#define BLYNK_PRINT Serial
#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>
#include <Wire.h>
#include <Adafruit_MCP4725.h>
char auth[] = BLYNK_AUTH_TOKEN;
char ssid[] = "Drive";
char pass[] = "1234567890";
int Relay2=23;
//int Relay3=12;
int Leftlimt=5;
int Leftlimtval;
int Rightlimtval;
int Rightlimt=4;
int backrelaypin=26;
int backrelayval=0;
int Speed=0;
int Forward;
int Steeringpin=15;
int Right;
int Left;
Adafruit_MCP4725 dac;
BLYNK_WRITE(V4) {
Speed=param.asInt();
 //dac.setVoltage(Speed, false);
 //Serial.println(Speed);
}
BLYNK_WRITE(V3) {
Right=param.asInt();
}
BLYNK_WRITE(V2) {
Left=param.asInt();
}
BLYNK_WRITE(V1) {
 backrelayval=param.asInt();
//Serial.println(backrelayval);
}
BLYNK_WRITE(V0) {
```

```
Forward=param.asInt();
}
void setup() {
  // put your setup code here, to run once:
  Serial.begin(115200);
  pinMode(backrelaypin,OUTPUT);
  digitalWrite(backrelaypin,HIGH);
  pinMode(Relay2,OUTPUT);
  digitalWrite(Relay2,HIGH);
  //pinMode(Relay3,OUTPUT);
  //digitalWrite(Relay2,LOW);
  pinMode(Steeringpin,OUTPUT);
  digitalWrite(Steeringpin,HIGH);
  if (!dac.begin(0x60)) {
    Serial.println("Couldn't find MCP4725!");
    while (1);
  }
dac.setVoltage(Speed, true);
    WiFi.begin(ssid, pass);
  Blynk.begin(auth,ssid,pass);
pinMode(Leftlimt,INPUT);
pinMode(Rightlimt,INPUT);
}
void loop() {
  // put your main code here, to run repeatedly:
 Rightlimtval=digitalRead(Rightlimt);
 Leftlimtval=digitalRead(Leftlimt);
  if (Forward==1) {
    dac.setVoltage(Speed, true);
    digitalWrite(backrelaypin,HIGH);
    Serial.println("F");
  }
   if (Forward==0 && backrelayval==0) {
    int Offspeed=0;
    dac.setVoltage(Offspeed, true);
    //digitalWrite(backrelaypin,HIGH);
    Serial.println("Fs");
  }
    if (backrelayval==1) {
    dac.setVoltage(Speed, true);
    Serial.println("B");
    digitalWrite(backrelaypin,LOW);
  }
if (Right==1 && Rightlimtval==1 ) {
     digitalWrite(Relay2,HIGH);
  //   digitalWrite(Relay3,HIGH);
    digitalWrite(Steeringpin,LOW);
  }
      if (Right==1 && Rightlimtval==0 ) {
     digitalWrite(Relay2,LOW);
  //   digitalWrite(Relay3,HIGH);
    digitalWrite(Steeringpin,HIGH);
  }
      if (Left==1 && Leftlimtval==1) {
     digitalWrite(Relay2,LOW);
    // digitalWrite(Relay3,LOW);
    digitalWrite(Steeringpin,LOW);
  }
       if (Left==1 && Leftlimtval==0) {
     digitalWrite(Relay2,HIGH);
    // digitalWrite(Relay3,LOW);
    digitalWrite(Steeringpin,HIGH);
  }
   if (Left==0 && Right==0) {
    digitalWrite(Relay2,HIGH);
    //digitalWrite(Relay3,HIGH);
    digitalWrite(Steeringpin,HIGH);
  }
Serial.println(Speed);
   Blynk.run();
 }
```

F. Monitoring Unit Circuit Diagram –

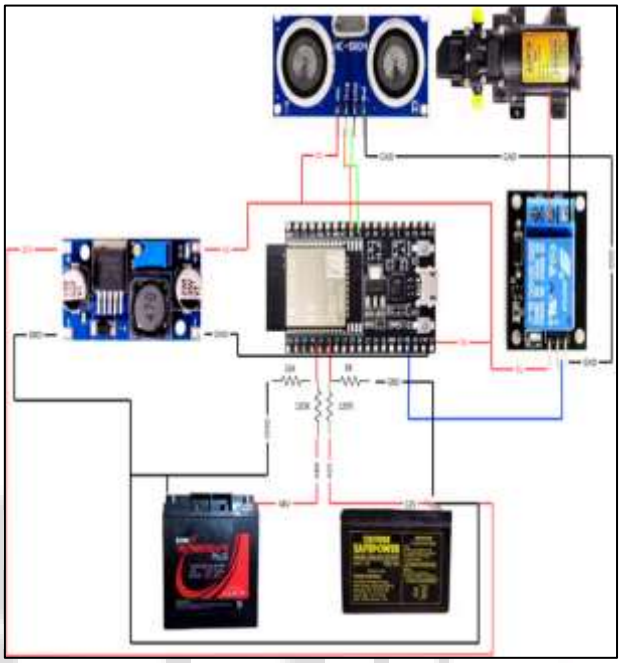

Fig. 7.5; Monitoring Circuit Diagram

G. Visual Interface of Monitoring System - Off Condition –

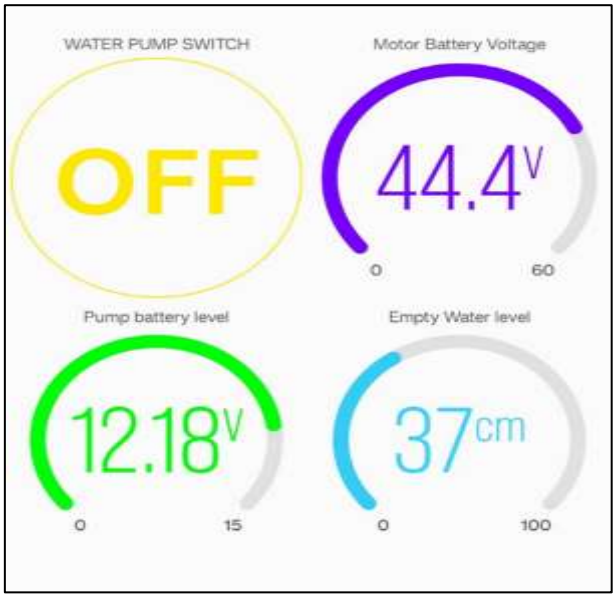

Fig. 7.6: OFF Condition Visual Interface

H. On Condition –

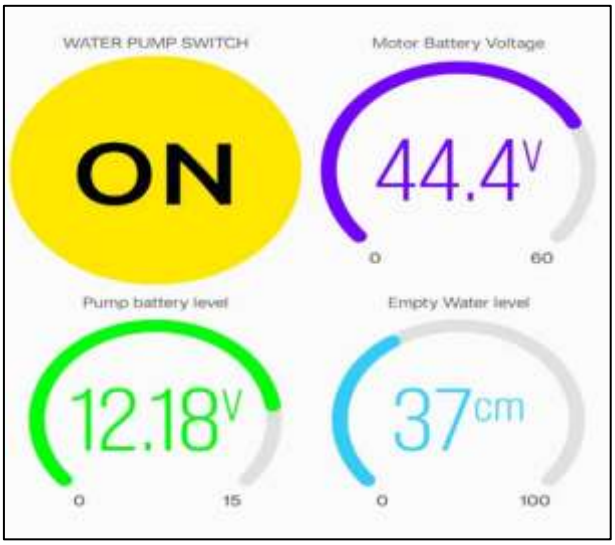

Fig. 7.7: ON Condition Visual Interface

I. Monitoring Circuit Code -

```
#define BLYNK_TEMPLATE_ID "TMPL35og8SBp8"
#define BLYNK_TEMPLATE_NAME "Monitoring"
#define BLYNK_AUTH_TOKEN "PgFqpwLlzaDUmoZ_V0STQR_I3yD1Zfyp"
#define BLYNK_PRINT Serial
#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>
#include <NewPing.h>
char auth[] = BLYNK_AUTH_TOKEN;
char ssid[] = "Meter";
char pass[] = "1234567890";
#define TRIGGER_PIN 18
#define ECHO_PIN 5
int relaypin=2;
int Batterypin=34;
float Batteryvoltage;
int Auxpin=35;
float Auxvoltage;
BlynkTimer timer;
NewPing sonar(TRIGGER_PIN, ECHO_PIN);
BLYNK_WRITE(V0) {
int RelayValue=param.asInt();
 if(RelayValue==1){
    digitalWrite(relaypin,HIGH);
 }
  if(RelayValue==0){
    digitalWrite(relaypin,LOW);
 }
 }
void Ultrasonic() {
  unsigned int distance = sonar.ping_cm();
  Blynk.virtualWrite(V3,distance);
  Serial.println(distance);
}
void Batteryval() {
  Batteryvoltage=analogRead(Batterypin);
float realBatteryvoltage=(60/4095.)*Batteryvoltage;
Blynk.virtualWrite(V1,realBatteryvoltage);
}
void Auxval() {
   Auxvoltage=analogRead(Auxpin);
float realAuxvoltage=(15.9/4095.)*Auxvoltage;
  Blynk.virtualWrite(V2,realAuxvoltage);

}
void setup() {
  pinMode(relaypin,OUTPUT);
  digitalWrite(relaypin,LOW);  // put your setup code here, to run once:
  WiFi.begin(ssid, pass);
  Blynk.begin(auth,ssid,pass);
  Serial.begin(115200);
  pinMode(Auxpin,INPUT);
  pinMode(Batterypin,INPUT);
  timer.setInterval(1000L, Ultrasonic);
   timer.setInterval(1000L, Auxval);
    timer.setInterval(1000L, Batteryval);
}
void loop() {
  // put your main code here, to run repeatedly:
   Blynk.run();
   timer.run();
```

J. Working -

This IOT based e-cart pesticide spray pump is designed to work on smart system which is based on IOT. This e-spray is automatically monitored and controlled through remote mobile system and can be operated as per the requirements of the farmer/user. This system is designed to power by batteries which are charged by solar panel of 100Watts. It makes it ecofriendly and low running cost. It also reduces the hard work of farmer/user to carry heavy traditional pesticide spray pump on his back. BLDC motors are used as drive motor for moving E-cart from one place to another while second motor is used to operate front wheel turning mechanism. Bothe motors are powered by 48V, 18A and 12V, 28A rating batteries respectively. All batteries are designed to charge through solar panel placed at upper side of e-cart. Two spray pumps are used to spray liquid pesticides with the help DC motors with 100Psi both. The spray system has one hand operated pressure nozzle spray gun and horizontally mounted multiple sprinkler nozzle spray system. A 40 litter pesticide tank is placed backside of e-cart driver. An ultrasonic level indicator is used to determine and monitor amount of spray in reservoir tank. Spray motor ON-OFF operation, vehicle driving in reverse - forward mode, both side turning, battery voltage level indicator and pesticide level indicator are monitored through mobile based Blink IOT android application. Disc brake system is used for smooth motion control of the E-cart. LED based head and back lights are provided for night operations. This designed spray system is based e-cart pesticide spray pump and is designed to work on smart system which is based on IOT. This e-spray is automatically monitored and controlled through remote mobile system and can be operated as per the requirements of the farmer/user. This system is designed to be powered by batteries which are charged by solar panel of 100Watts. It makes it ecofriendly and low running cost. It also reduces the hard work of farmer/user to carry heavy

traditional petrol operated pesticide spray pump on his back. BLDC motors are used as drive motor for moving e-cart from one place to another, while second motor is used to operate front wheels turning mechanism. Both motors are powered by 48V, 18A and 12V, 28A rating batteries respectively. All batteries are designed to charge through solar panel placed at upper side of e-cart. Two spray pumps are used to spray liquid pesticides with the help DC motors with 100Psi both. The spray system has one hand operated pressure nozzle spray gun and horizontally mounted multiple sprinkler nasal spray system. A 40 litter pesticide tank is placed backside of e-cart driver. An ultrasonic level indicator is used to determine and monitor amount of spray in the reservoir tank. Spray motor ON-OFF operation, vehicle driving in reverse - forward mode, both side turning, battery voltage level indicator and pesticide level indicator are monitored through mobile based Blink IOT android application. Disc brake system is used for smooth motion control of the E-cart. LED based head and back lights are provided for night operations.

VIII. RESULT AND DISCUSSION

- All the power requirements for e-cart and spraying operation are provided by a 100W solar panel placed at top of e-cart.
- All running operations like turn, speed control, forward-reverse of e-cart functions automatically through Blink IOT application on android mobile.
- Nozzle sprinkler motor on-off function is controlled through Blink IOT android application.
- e-cart is successfully tested for average 30kmph speed with desired load on normal road and about 20kmph in the field.
- A maximum 40L pesticide mixture can be sprayed by the operator using hand gun and nozzle.
- The pesticide level inside reservoir tank is monitored and communicated to operator through Ultrasonic Level Indicator on Blink IOT app.
- Battery voltage levels are communicated to the operator through Blink IOT app.
- Additional charging adaptor is provided for emergency charging.
- Designed e-cart spray system shows satisfactory usages for night operations also.

Sr. No.	Observation on Parameter		Observed recording
1.	Maximum Speed	On Road	30 Km/hr
		In Farm	20 Km/hr
2.	Maximum range	On Road	32.7 Km
		In Farm	½ Acer
3.	Weight Carrying Capacity	On Road	200 Kg
		In Farm	150 Kg.
4.	Area covered in 1 Full Tank	In Farm	7500 Sq. feet.
5.	Area Covered in Single Charge (0-100)	In Farm	½ Acer
6.	Auto Operation Range	On Road	32.7 Km
		In Farm	½ Acer
7.	Charging Time	By Solar	10 Hr
		By Charger	3.5 Hr

The various observed parameters, results of design system are as follows:

Table 2:

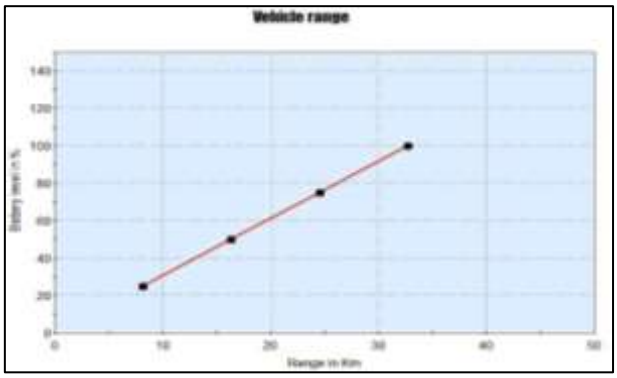

Fig. 8.1: Vehicle Range Graph

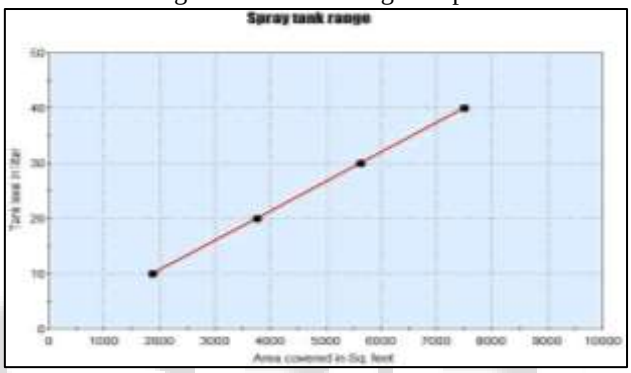

Fig. 8.2: Spray tank Range Graph

IX. ADVANTAGES

1) Advance technology and low maintenance & operational cost.
2) No manual human assistance necessary during auto operation mode.

3) Human operational mode is also provided.
4) No consumption of any fossil fuels which is non-renewable source of energy which reducing pollution and harm to the nature.
5) Live controlling by using IOT application.
6) Work in all types of farms.
7) Head light system is given so it can be used at night also.
8) Less human power required.

X. APPLICATION

1) It will be useful for every type of farming.
2) It is used in gardening purpose.
3) It is used in sports ground like cricket stadium and football stadium.
4) Spraying sanitizer in Hospital's
5) It will also use for short distance traveling with load as an E-Vehicle.
6) Multipurpose

XI. FUTURE SCOPE

- More fully automatic functioning.
- Addition of GPS and tracking system.
- The batteries can be replaced with more efficient lithium-ion batteries which would be adding the effectiveness of model.
- Improve the electronic circuit and coding for auto control to run the vehicle itself at a given specific distance.
- More impressive look design like commercial vehicle.

XII. CONCLUSION

- E-cart and spraying operation are powered by a solar panel making it ecofriendly and no fuel pollutant emissions as compared to traditional petrol spray pumps.
- No need to carry pump and pesticide mixture load by the farmer/operator.
- Reduces Work and body efforts of operator/farmer.
- Nozzle sprinkler spraying is carried by an auto control and covers more field area in short time.
- The pesticide level is monitored and communicated to operator successfully.
- Less human assistance requirement during auto operation.
- More user-friendly operating control for any normal village farmer.

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