Automatic Pesticide Sprayer for Agriculture Purpose

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Abstract- *A robotics-based guidance method is presented to guide a robot platform which is designed independently to drive through the crops in a field according to the designed concept of open architecture. Thus, the robot platform is designed in real time to guide the platform on the basis of detection of crop using Ultra-Sonic sensor. The proposed system is basically developed to implement an agricultural production. This type of system is very useful in agriculture field where we need to spray the pesticide to different crops. This system automatically sense crop of both sides by using ultra-Sonic sensor. Embedded Chip ARM 7 LPC2148is heart of this work and the system and KEIL C software is used to code the algorithm.*

I. INTRODUCTION

An ARM based system is presented to guide a robot platform which is designed independently to drive through the crops in a field according to the design concept of open architecture. Then, the offset and heading angle of the robot platform are detected in real time to guide the platform on the basis of recognition of a crop using ultrasonic sensor. This project is basically developed to implement an agricultural production.

This type of system is very useful in agriculture field where we need to spray the pesticide to different crops. This System automatically sense crop of both sides by using ultrasonic sensor. If it senses the crops, than it will automatically starts to spray. If it detects both sides it starts to spray both sides.

In this system we are using embedded chip LPC2148 to control the operation of the system. In this system we use small tank in that we add pesticide and place motor. Whenever the sensors detect the plant, the signal is given to embedded chip and it will turn on the motor and start to spray. By making some modification we can use for other applications also.

1.1 FEATURES:

1. Moves in forward direction.
2. Moves in reverse direction.
3. Speed controls in both the direction.
4. It can even turn left or right while moving forward or in reverse direction.
5. Instant reverse or forward running without stopping on the spot left or right turn to pass through the narrow space.

1.2 TECHNICAL SPECIFICATION:

1. It operates on 3.3Vdc.
2. Low power consumption: In active Mode 25milli amp.In power down mode in microampere.
3. Operating frequency 12 MHz.
4. Operating Voltage of RF module 5Vdc.
5. Operating frequency of RF module 433 MHz.

HARDWARE:

1. ARM development tool.
2. ULINK tool.

SOFTWARE:

1. KEIL C

II. BLOCK DIAGRAM DESCRIPTION

The block diagram of proposed system consists of three main components:

- Transmitter
- Receiver
- Sprayer

2.1 TRANSMITTER

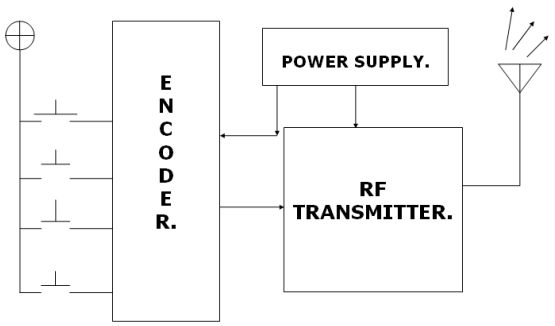

Fig 2.1.1: Block diagram of Transmitter

The transmitter consists of Keypad, Encoder and RF transmitter the description of each block is given in following subsections.

KEYPAD:

Keypad is just like a remote which generates signals to control the direction of a moving robot. Keypad has 4 keys; each key is designed to drive the robot in one particular direction. Thus the transmitter has a 4 buttons namely F [Forward], R [Reverse], L [Left], R [Right] and there are 4 corresponding outputs at the receiver. Each key is designed to drive the robot in one particular direction.

ENCODER:

The 2^12 encoders are a series of CMOS LSIs for remote control system applications. They are capable of encoding information which consists of N address bits and 12_N data bits. Each address/ data input can be set to one of the two logic states. The programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium upon receipt of a trigger signal. The capability to select a TE trigger on the HT12E or a DATA trigger on the HT12A further enhances the application flexibility of the 2^12 series of encoders. The HT12A additionally provides a 38kHz carrier for infrared systems.

RF TRANSMITTER:

RF transmitter transmits the signals depending on the key pressed. And it operates with the frequency of 433.92 MHz and current consumption is about 12mA. Supply voltage is 5V.

2.2 RECEIVER

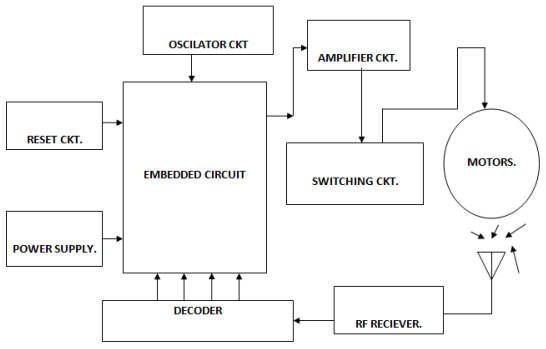

Fig 2.2: Block diagram of Receiver

The Receiver consists of RF Receiver, Amplifier and Reset Circuit. The description of each block is given in following sub sections.

RF RECEIVER:

RF receiver receives the signals from the transmitter depending on the key pressed. And it also operates with the frequency of 433.92 MHz and current consumption is about 12mA and supply voltage is 5V.

AMPLIFIER:

Amplifier amplifies the signals received at the receiver. The amplifier used is ULN2803.This amplifier has 8 built in not gates. Hence the signals outputted from the amplifier are inverted. These inverted signals are then used to drive circuit block.

DECODER:

The 2^12 decoders are a series of CMOS LSIs for remote control system applications. They are paired with Holtek's 2^12 series of encoders. For proper operation, a pair of encoder/decoder with the same number of addresses and data format should be chosen. The decoders receive serial addresses and data from a programmed 2^12 series of encoders that are transmitted by a carrier using an RF or an IR transmission medium. They compare the serial input data three times continuously with their local addresses. If no error or unmatched dcodes are found, the input data codes are decoded and then transferred to the output pins. The VT pin also goes high to indicate a valid transmission. The 212 series of decoders are capable of decoding information that consists of N bits of address and 12_N bits of data. Of this series, the HT12D is arranged to provide 8 address bits and 4 data bits, and HT12F is used to decode 12 bits of address information.

RESET CIRCUIT:

It consists of 5V-power supply with the arrangement of 10K pull up resistor and 0.1Mf ceramic capacitor. In additional to this a low bit MCLR switch is connected to the circuit that is manually operated.

2.3 SPRAYER

The Sprayer consists of Switching circuit, Motor, Camera, Ultra-sonic sensor Oscillator, Embedded Chip. The description of each block is given in following sub sections.

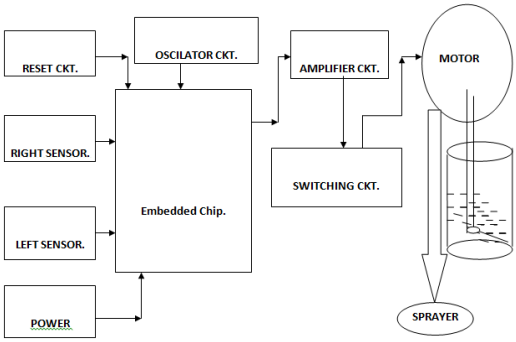

Figure 2.3: Block diagram of Sprayer

SWITCHING CIRCUIT:

Switching circuit consists of relays. These relays are used to control the motor operation which in turn controls the robot movement. Four relays are used and voltage to operate relay is 12v dc.

MOTOR:

The dc motor is used to drive the robot. These motors can be made to rotate in either direction by supplying the voltage accordingly.

CAMERA:

Camera is operated with 9V DC supply. The pictures are taken by camera and are sent through antenna to get transmitted.

OSCILLATOR:

Normally the embedded chip works under the frequency of 4 MHz, so to generate this frequency we are making use of the crystal oscillator of 4 MHz with the parallel arrangement of 27pf capacitor which helps to produce the stable frequency.

ULTRASONIC SENSOR

This sensor is used to detect the plants. Systems typically use a transducer which generates sound waves in the ultrasonic range, above 18,000 hertz, by turning electrical energy into sound, then upon receiving the echo turn the sound waves into electrical energy which can be given to ARM processor.

III. WORKING OF AUTOMATIC PESTICIDE SPRAYER

Automatic pesticide sprayer is operated in three stages:

1. Transmitter.
2. Receiver.
3. Sprayer.

TRANSMITTER CIRCUIT:

Keypad has 4 keys. Each key is designed to act as a switch. Thus the transmitter has a 4 buttons namely F [Forward], R [Reverse], L [Left], R [Right] and there are 4 corresponding outputs at the receiver. Each key is designed to drive a vehicle in one particular direction. The encoder codes the signal to retain the data and thus minimizes the data loss. The encoded data is then transmitted from the transmitter end to the receiver end using a RF transmitter. The RF TX operates with the frequency of 433 Hz. 6V DC Battery is used as power supply circuit for this transmitter circuit.

RECEIVER CIRCUIT:

The encoded data is received from the receiver end using a RF receiver and given to the decoder. The decoder decodes the signal to retain the data and thus minimizes the data loss. The RF RX also operates with the frequency of 433 Hz.

Embedded Chip ARM 7 LPC2148: This is the heart of the project where we load or write our actual program to control the peripheral connected to this experiment.

OPERATION:

Here the receiver circuit used to change the direction of moving vehicle. Let us consider any one key is pressed, say the key L is pressed, the output line 1 of the decoder is activated or the decoder outputs signal on its first o/p line. This is then given to the ULN2803 amplifier. The signal which is given to the amplifier gets inverted and the inverted signal is then given at the output. i.e., logic 1 at the amplifier input is converted as logic 0 at the output. This negative supply is then used to drive the first relay (or R1).The relay switches and make the motor to rotate the vehicle towards left. Relay acts as a switch. It has 5 terminals. They are positive (+), negative (-), normally closed (NC), normally open (NO) and common terminals. Always the common terminals reside to towards the normally closed terminal side. Relay operates with 12v dc supply. When the 12vdc is given to the positive terminal & 0v to the negative terminals the relay switches on. The electromagnetic field is generated and the common terminal switches towards the normally open terminal. These changes make the motor, to get 12vdc supply at its positive terminal and 0v at its negative terminal. If this condition satisfies, then the vehicle is rotated towards left.

The key R is designed to move the vehicle towards right. When the R [4th] key is pressed the 4th line of the decoder sends signal high to the amplifier. This high signal is inverted and so we obtain the low signal at its output. Low signal is then given to therelay R3.The relay operates similarly as explained previously and the motor2 is rotated, thus making the vehicle to move towards right.

The keys 1 and 3 together drive the vehicle in the forward direction. When these two keys are pressed at a time, the relays R1 andR3 operate at once and move the vehicle in the forward direction. By pressing keys 1 and 3 high signals are obtained at the output of a decoder on its first and third line. The same high signal is given to the amplifier. The amplifier outputs low signal, this low signal switches the relay R1 & R3. This in turn activates motor 1 & 2. When the two motors are being supplied with 12v they rotate and move the vehicle in the forward direction.

The keys 2 & 4 together drive the vehicle in the reverse direction. When these two keys are pressed at a time, the relays R2 & R4 operate at once make the vehicle to move in reverse direction. When the keys 2 & 4 are pressed simultaneously, decoder output high signals at the output on these lines particularly. The o/p of the decoder is given to the amplifier. The amplifier then converts high signals to low signals. These low signals are used to drive the relays R2 & R4. When the relay R2 operates, the positive 12v is supplied to the negative terminal of the motor1 and negative voltage is supplied to the positive terminal of the motor1.This is the main reason for the vehicle to move in reverse direction. Thus the motor1 is made to rotate in the reverse direction similarly relay R4 operates along with the relay R2 and make the vehicle to move backward.

SPRAYER:

This system has two sensors, one sensor is placed in left side to detect the plants at left side and another sensor is placed in right side to detect the plants at right side. The outputs of both these sensors are given to the ARM. When this sensor does not detect any plant they will give logic zero at their output. When right side sensor detect the plant it will give logic high to a particular pin of ARM processor, when processor get logic high on its input pin, it will make a particular output pin port 1.17 as high for some delay. This is then given to the ULN2803 amplifier.

The signal which is given to the amplifier gets inverted and the inverted signal is then given at the output. i.e., logic 1 at the amplifier input is converted as logic 0 at the output. This negative supply is then used to drive the first relay. The relay switches and makes the motor to rotate the sprayer towards right according to given delay after that the processor make that pin low and stop sprayer rotation. After this the processor give logic high on port P1.18 for some time. This is then given to the ULN2803 amplifier. The signal which is given to the amplifier gets inverted and the inverted signal is then given at the output. i.e., logic 1 at the amplifier input is converted as logic 0 at the output. This negative supply is then used to drive the second relay.

The relay switches and makes the motor inside the sprayer on and start to spray according to given delay and after that it will stop when processor give logic zero on pin P1.18. After that again processor will make a particular output pin port P1.19 as high for some delay. This is then given to the ULN2803 amplifier. The signal which is given to the amplifier gets inverted and the inverted signal is then given at the output. i.e., logic 1 at the amplifier input is converted as logic 0 at the output. This negative supply is then used to drive the third relay. The relay switches and makes the motor to rotate the sprayer towards left according to given delay after that the processor make that pin low and stop sprayer rotation and come to previous position.

When left side sensor detect the plant it will give logic high to a particular pin of ARM processor, when processor get logic high on its input pin, it will make a particular output pin port 1.19 as high for some delay. This is then given to the ULN2803 amplifier. The signal which is given to the amplifier gets inverted and the inverted signal is then given at the output. i.e., logic 1 at the amplifier input is converted as logic 0 at the output. This negative supply is then used to drive the first relay. The relay switches and makes the motor to rotate the sprayer towards left according to given delay after that the processor make that pin low and stop sprayer rotation. After this the processor gives logic high on port P1.18 for some time. This is then given to the ULN2803 amplifier. The signal which is given to the amplifier gets inverted and the inverted signal is then given at the output. i.e., logic 1 at the amplifier input is converted as logic 0 at the output. This negative supply is then used to drive the second relay.

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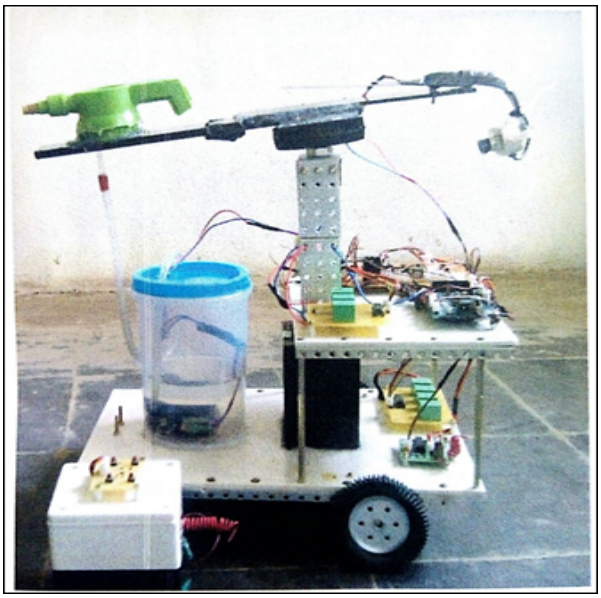

Figure 2.4 : Overall view of proposed system

IV. FUTURE SCOPE

Technology is ever growing and there is always scope for improvement and advancements in every field of work.

In future we can implement this system that can give indication after completion of pesticide. We can also make use of GSM model to send message when pesticide is finished.

V. RESULTS

This type of system is very helpful for agriculture purpose where need to spray the pesticide to different crops. Currently we use a system that increase the human effort and it also not comfortable. This pesticide sprayer robot move in fields and robot has sensors to detect the plants on both sides. In this system we use small tank for pesticides and motor. If it detects plant then automatically it will starts to spray. This system also has a wireless camera which can capture the image and display it on the display. By making some modification we can use this system for other type of application.

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