

AGRIBOT - A MULTIPURPOSE AGRICULTURAL ROBOT

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ABSTRACT: Agribot is a robot designed for agricultural purposes. It is designed to minimize the labor of farmers in addition to increasing the speed and accuracy of the work. It performs the elementary functions involved in farming i.e. ploughing the field, sowing of seeds and covering the seeds with soil. The robot is autonomous and provides the facility for optional switching of the ploughing system when required. PSoC (Programmable System on Chip) controller from Cypress Semiconductor, USA is used to control the robot.

I INTRODUCTION:

Many countries in Asia including India are agrarian economies and most of their rural populations depend on agriculture to earn their livelihood. Aimed at increasing the productivity and reducing the labor involved, this robot is designed to execute the basic functions required to be carried out in farms

The robot starts its function by ploughing the field, then sows the seeds in the ploughed area and ends the process with covering the seeds sown with soil. It uses basic components like DC motors, stepper motor, relay and PSoC as the main controller. The mechanical design of the robot is also simple. It is programmed to carry out the above functions simultaneously. To perform the function of ploughing it is equipped with spiked wheels which are fixed in the anterior end of the robot, to sow seeds it has a container with seeds and its bottom contains a perforation to drop the seed and finally the posterior end of the robot has a sloping metal sheet touching the ground to cover the sown seeds with soil as it moves forward.

II CONSTRUCTION:

The chassis of the robot is fixed to two wheels and the movement of these wheels is controlled using DC motors as shown in Fig. 1. An additional DC motor is also used to control the spiked wheels which dig. The control of the seeds can be done in two ways: It can be controlled using stepper motor or it can be done using a relay. A tough metal sheet is attached at the end of the robot to cover the seeds with soil. To enable this function the metal sheet is attached such that its slope touches the ground.

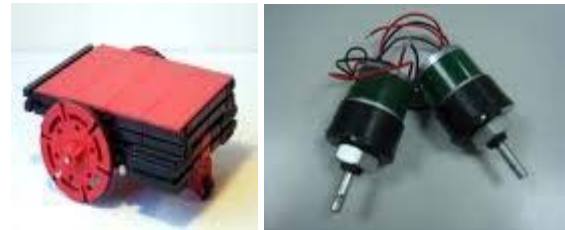


Fig 1 Chasis and controlling motors of the Robot.

III MECHANISM:

The robot is placed in the field and is switched on. This enables the movement of its wheels. To start ploughing another switch is turned on. This starts the rotation of spiked wheels (shown in Fig. 2) and thus starts ploughing which is done simultaneously as the robot moves forward. As the spiked wheels are in the front, a container is used for holding the seeds. A hole is drilled in the bottom of this container and that is covered with a small metal sheet. This sheet acts as a flip-flop and caters to the dropping of seeds at periodic intervals. The control of the flip-flop as mentioned above can be done in two ways.

A) Using stepper motor:

The flip-flop metal sheet is connected to a stepper motor. As the stepper motor rotates to a specific angle the flip-flop opens and a seed is dropped. Then, immediately it rotates the same angle in reverse direction thus, closing the flip-flop.

B) Using a relay:

A relay can be used instead of a stepper motor. Whenever the coil terminals are excited the soft iron surrounded by coil acts as electro magnet and it attracts the moving armature to connect to Contact terminal B. Whenever there is no excitation the moving armature is held at contact A due to the spring action. As soon as there is an excitation the coil acts as an electromagnet and pulls the armature towards itself, thus causing the function of opening the lid. The above concept can be co-related to the dropping of seeds. The excitation can be used to attract the metallic lid of the container and hence drop the seed in the required place.



Fig 2 Components used for ploughing and seed dropping

The final step is covering the sown seeds with soil. For this no additional mechanism is required. At the end of the robot a sloping metal sheet is attached so as to enable the covering with soil as the robot forward. The following Fig. 3 shows a sample of the soil ploughed.



Fig 3 A sample of field ploughed with the robot

IV CONTROL OF THE ROBOT

The robot is controlled using the PSoC controller [1]. It is programmed to enable all the above mentioned functions. The block diagram of PSoC components used is shown below:

PSoC blocks used: 3-digital blocks (configured as Timer);
0 analog blocks.

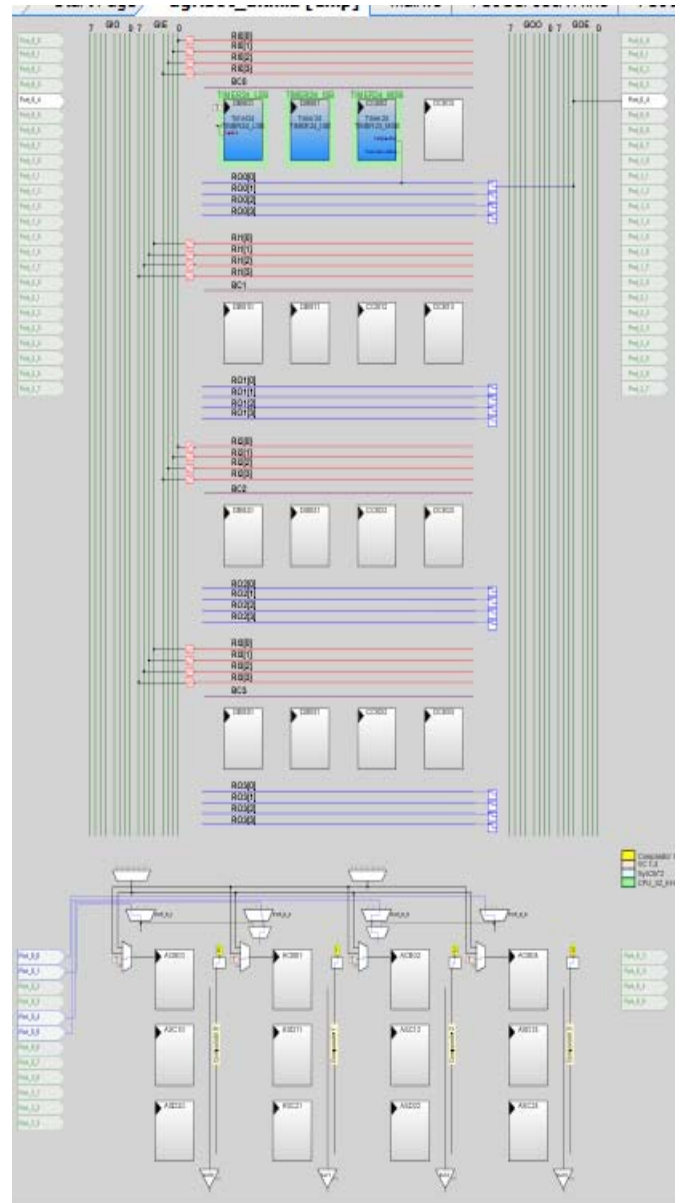


Fig 4 Internal hardware block diagram of PSoC controller.

PSoC Global resources configuration is shown in Table-I. The parameters set the power setting for the PSoC and set the desired clock frequency for timer to 400Hz using VC1, VC2 and VC3.

Global Resources - agribot_... ▾ 🔍 ✕	
Power Setting [Vc 5.0V / 24MHz	
CPU_Clock	SysClk/8
32K_Select	Internal
PLL_Mode	Disable
Sleep_Timer	512_Hz
VC1= SysClk/N	15
VC2= VC1/N	16
VC3 Source	VC2
VC3 Divider	250
SysClk Source	Internal
SysClk*2 Disable	No
Analog Power	SC On/Ref Low
Ref Mux	(Vdd/2)+/-BandGap
AGndBypass	Disable
Op-Amp Bias	Low
A_Buff_Power	Low
SwitchModePump	OFF
Trip Voltage [LVD	4.81V (5.00V)
LVDThrottleBack	Disable
Watchdog Enable	Disable

Table 1 PSoC Global Resources Configuration

The timer settings to obtain the desired operation are shown in Table-II. Here the output time period obtained (from the settings shown in Table-II) is 2s

Properties - Timer24 ▾ 🔍 ✕	
Name	Timer24
User Module	Timer24
Version	2.6
Clock	VC3
Capture	High
TerminalCount	
CompareOut	Row_0_Output_0
Period	800
CompareValue	400
CompareType	Less Than Or Equal
InterruptType	Capture
ClockSync	Sync to SysClk
TC_PulseWidt	Full Clock
InvertCapture	Normal

Table II Timer Configuration Details

The code in PSoC to execute the mentioned functions are shown below:

```
#include <m8c.h> // part specific constants and macros
#include "PSoC_API.h" // PSoC API definitions for all
User Modules

#pragma interrupt_handler io_interrupt

void main()
{
    M8C_EnableGInt; //Enable Global interrupts of M8C
microcontroller
    M8C_EnableIntMask(INT_MSK0,INT_MSK0_GPIO);
//Enables General Purpose IO pins interrupt.
    Timer24_EnableInt(); //Enable Timer Interrupts
    Timer24_Start(); //Starts the timer
    while(1);
}

void io_interrupt()
{
    if(PRT1DR & 0x01) //checks the status of PIN
0 of PORT 1
    {
        if(PRT0DR && 0x04) //To ON and
OFF the digger
            PRT0DR &= 0xF0;
        else
            PRT0DR |= 0x04;
    }
    if(PRT1DR & 0x02) //checks the status of PIN
1 of PORT 1
    {
        if(PRT0DR &= 0x01) //To ON and OFF
the entire robot
            PRT0DR &= 0xFE;
        else
            PRT0DR |= 0x01;
    }
    return;
}
```

The code performs the following operations:

1. The Timer24_Start() starts the timer which is used to open and close the lid for seed dropping.
2. The I/O interrupt function will execute when there is rising edge detected on the i/o pins.
3. The first if condition is used to ON and OFF the digger and the second if condition is used to ON and OFF the entire robot.

Thus the above mentioned code makes the robot autonomous in performing all the functions required. The schematic diagram of controls in the robot is shown in Fig. 5.

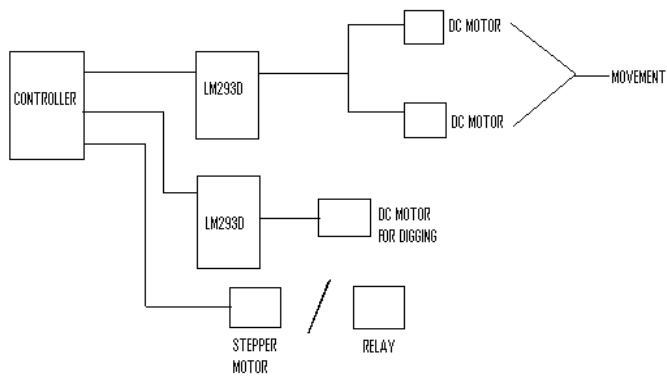


Fig 5 Overall Control of the Robot

V. Conclusion

In this work a robot, named, AGRIBOT, has been designed, built and demonstrated to carry out ploughing in an agriculture field. It is expected the robot will assist the farmers in improving the efficiency of operations in their farms. This work has been carried out as an undergraduate research project.