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DEVELOPMENT OF PROTOTYPE MODEL OF AUTOMATIC SOWING MACHINE

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ABSTRACT

The conventional sowing machines used by farmers in the fields to sow the crops are operated either by manual or by using animals like bullocks, etc. To help them by avoiding the use of animal an automated solar powered sowing machines has been proposed. The present working model related to sowing machine comprises of a seed distributor as explained in this project work. The description is focused on design and development activities. The machine designed here performs important function of calculating the distance in centimetres according to the data entered in to the microcontroller through keyboard, the data is nothing but where the seed has to be planted horizontally in a row. After planting all the seeds in one particular row, the seed planting mechanism comes back to its original place and again according to the data already generated previously, the vehicle moves further up to a certain specific distance to plant the seeds in another row.

Keywords: *Sowing, Machine, Automatic, Prototype, Development, Model.*

I. INTRODUCTION

This project work comes under the subject of Mechatronics. Today Mechatronics has become an applied Engineering science that includes diverse fields like control theory, microelectronics, mechanical engineering, Electrical engineering and artificial intelligence. These types of mechanical creations are called as Mechatronics or electro-mechanical machines ranging from simple machines to highly complex, controlled by micro-controller devices [1]. Also variety of machines are developed for wide applications like levelling the soil, cutting and collecting the full-grown crop, seed planting, segregating and packing, etc.

An 89C51 microcontroller is used as control system of the entire machine. The software is prepared in machine language and depending up on the information given by the keyboard and based on the control algorithm, the motors used in the project work controls entire mechanical transmission section [2]. Limit switches are used and they are arranged at various points of mechanical structure to identify the position of various mechanical transmission sections.

Depending up on the program, the microcontroller generates the output to control the machine through four motors and one solenoid coil. The major two mechanical transmission sections
(i)   Moving the vehicle in forward and reverse directions.
(ii)   Moving the seed planting mechanism horizontally are designed with two stepper motors, because here precision control is essential [3].

The most common stepper motors have multiple field windings and a permanent magnet rotor. The rotor is made to rotate by means of electronically commutating (switching) the current in the field windings [4, 5]. These motors are designed to operate indefinitely with DC voltage applied to one or more fields in order to hold the rotor in a fixed position. The rotor will rotate in discrete steps when the fields are energized in a specific sequence. Stepper motors are designed to rotate a fixed number of degrees with each step. A 1.8-degree stepper motor requires 200 steps for the rotor to make a full revolution [6].

The heart of the project work is microcontroller. Since this chip is having lot of I/O lines entire electronic and electrical hardware is interfaced with single chip. Thus, the trend is directing towards micro-controller based project works [7]. The other advantages include cheaper maintenance, decreased hardware design effort and decreased board density, which is relevant in portable control equipment.

Low cost high volume products requiring a relatively simple and cheap computer controller have traditionally characterized micro-controllers. The design optimization parameters require careful consideration of architectural tradeoffs, memory design factors, instruction size, memory addressing techniques and other design constraints with respect to area and performance. Micro-controllers functionality, however, has been tremendously increased in the recent years. Today, one gets micro-controllers, which are stand alone for applications in data acquisition system and control [8, 9]. In this project work ATMEL 89C51 micro-controller is used which is 8-bit micro-controller.

II.   METHODOLOGIES

2.1 Seed planting mechanism

The mechanical transmission section is designed with screw rod and sliding channels, two sliding channels are used to avoid the deviation. These channels are having ball Barings so that the mechanism moves smoothly without any friction. The screw rod is directly coupled to the motor shaft. Here a heavy duty motor of 5 Kg holding torque is used such that it can drive entire mechanism directly without any gear box.

Initially the movement of the mechanism is to be calculated, to know when the motor completes one full revolution how far the mechanism is moved either in forward direction or reverse direction. The calculation is based on the screw rod diameter and its pitch value.
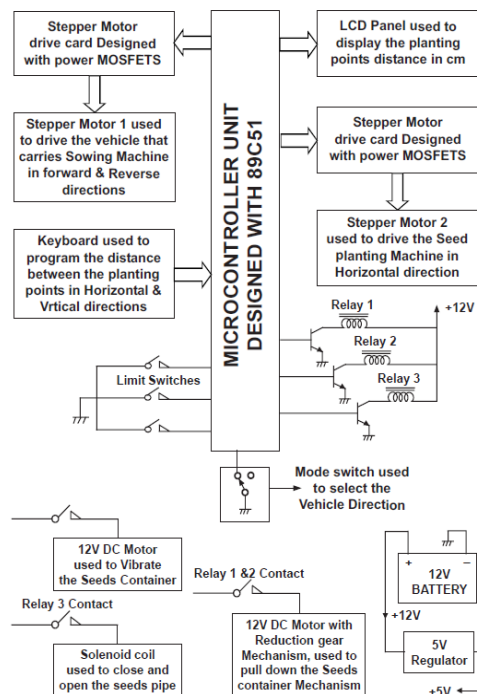

Fig.1.block diagram

Here 12mm rod is used and the pitch value is 1.2mm. As the screw rod diameter increases pitch value also increases, sometimes the pitch may differ from rod to rod; there by here physically the movement is measured with scale. If 1.2 mm pitch rod is selected, then to move the mechanism by 12 mm, the motor has to complete ten revolutions. Since un-

known pitch rod is used, here the movement is measured physically based on the pulses produced by the controller. Here the mechanism is designed to plant the seeds within 40 centimetres, for this purpose 50 cm's screw rod is selected. Since the planting mechanism requires some clearance, the reference point is made after 10mm clearance, hence the mechanism moves between zero reference points to maximum 40 cm's. The other reference points, means where the seeds are supposed to be planted can be programmed through keyboard. The machine is designed such that the seeds can be planted anywhere in that particular row within 40 cm's range. Similarly number of seeds that are supposed to be planted in that row also can be programmed through same keyboard. Once the data is finalized, the machine repeats and plants the seeds at same dimensions in next row, the process is repeated and continued until we stop the machine by pressing the clear key. After this new program can be entered through the same keyboard, like wise every time program can be changed and distance can be adjusted depending up on the seed type.

While planting the seeds, the planting mechanism should be brought near to the soil; if possible the seed planting pipe should plunge in to the soil up to certain distance. A small teethed wheel is directly coupled with DC motor shaft and it is aligned with chain, to identify the ground level here at bottom side of the seed planting mechanism one long lever switch is arranged. This switch is activated automatically, when plating pipe almost touches to the ground. The output of the switch (generates logic low level) is fed to microcontroller, there by the controller can understand the position of the pipe and immediately the controller breaks supply to the motor through relay contact.

The seed planting pipe is divided in to two sections. It means it is made into two separate pieces and is arranged as see through manner. Here to create obstacle between two pipes solenoid coil is used, this obstacle is supposed to be removed during the seed planting time. The idea of creating this obstacle is to stop the flow of seeds through the pipe, here a small metallic plate is used as obstacle and it is arranged between the two pipes. This plate is welded with solenoid coil rod, here a power full coil is used and it is designed to operate at 12V DC.

Depending up on the planting program, the seed planting mechanism covers all reference points in a particular row, whenever it reaches to a particular reference point, the controller energizes the relay for fraction of milliseconds. This relay contact is used to provide supply to the solenoid coil, there by obstacle is cleared for few milliseconds, which in turn only one or two seeds are allowed through the pipe for planting.

2.2 Vehicle driving mechanism
For any Motorized moving body, chassis is the major part, which carries all the components required to drive the vehicle. An automotive vehicle needs many sub-systems like Engine, Frame, Clutch, Gear Box, Steering assembly rear and front axle assembly, break assembly, Fuel tank, etc., The Motorized vehicle is designed with simple Mechanism, which eliminates all above sub-systems. This system needs very few electric and electronic components like Battery, Stepper Motors, DC motors and control circuit. Since it is a battery-operated vehicle, it can be called as "Electric Sowing machine". Heavy-duty battery is used to drive the vehicle; once the battery is discharged it has to be charged with battery charger designed using single phase supply.

The movement of the vehicle also can be programmed independently through the same key board. Here after planting all the seeds in one particular row, the vehicle is supposed to be moved forward up to specified distance to plant the seeds in another row.

This input pin of controller is programmed such that, as long as the switch is not activated the vehicle runs in forward direction, whenever the switch is activated this particular pin is grounded through switch there by the vehicle runs in reverse direction. The following is the description of running speed and distance travelled calculations.

2.3 Roll of LCD
Initially when the machine is energized, the display shows 'WELCOME' and after that project title is displayed. When the machine is supposed to be run in auto mode, number two key of keyboard has to be depressed, here the system asks the user through display, weather the machine is to be run in auto mode or manual mode. After activating number two key, co-ordinates data must be entered through same key board. During the planting process each co-ordinate data, means at what distance the seed has to be planted will be displayed in centimetres.
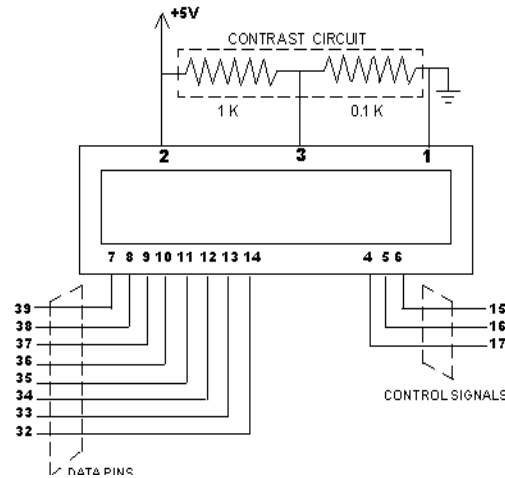
Fig: 2 interfacing the display unit to the Microcontroller

2.4 Stepper motor
Stepper motors have multiple stepping modes, full stepping, half-stepping and micro stepping. To rotate the motor, only four distinct input combinations or states are required to rotate the rotor. Generally for precise position of mechanical movements, stepper motors are used.

2.5 Solenoid coil
Another important active device used in the project work is Solenoid coil. This coil is used to control the seeds. Supply to this coil is provided through relay contact, for this purpose normally open contact is used whenever the seed is supposed to be planted at particular point. The controller energies this relay and supply is provided to the solenoid coil.
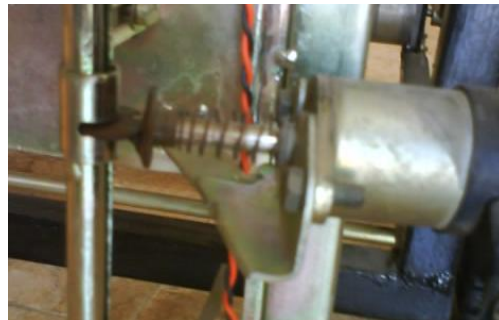

Fig: 3 Solenoid coil

III.   CIRCUIT DIAGRAM DESCRIPTIONS

3.1 Circuit analysis
The detailed circuit description of the project work **"**Automatic Sowing machine" is explained along with circuit diagram.
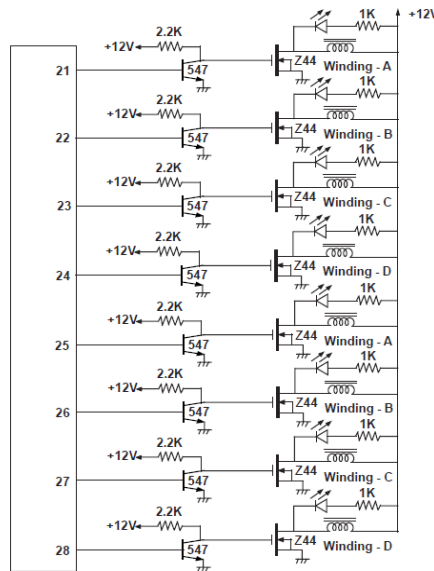
Fig: 4 circuit diagram of stepper motors driving through power MOSFETS

3.2 Keyboard

In this section, to make the machine as automatic, the data is to be entered in to the microcontroller through the keyboard. Hence the key board is playing major roll in this project work the source of information is keyboard. The digital information produced by the keyboard by pressing the keys is converted in to binary code.

Out of 12 keys, 10 keys are utilized to generate co-ordinates data in centimetres. For this purpose 0 - 9 numeric numbers are created; the remaining two keys are used to perform clear and go functions. These 12 keys are arranged to form 3x4 matrixes (three rows and four columns), each row is having four keys and each column is having three keys.
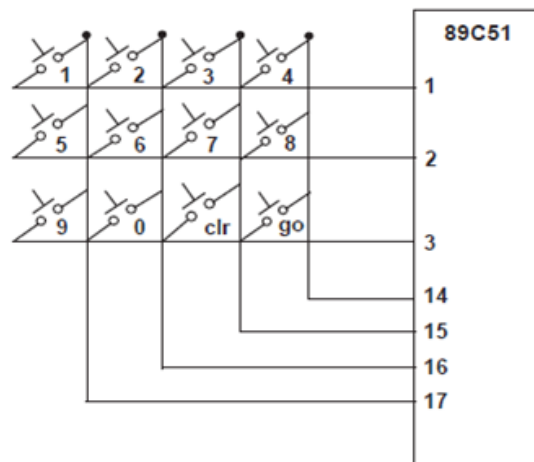

Fig: 5 Keyboard connected to ports

3.3 Stepper Motor Drive Circuit

Similarly to drive the motor in anti-clockwise, the sequence starts from the bottom to top. Likewise the motor rotates in both the directions. In this Project work two Stepper Motors are used. The Commands for each coil of the stepper Motor is fed through Micro Controller. The output of the controller is used to drive the switching transistors BC 547.

Finally these switching transistors drive MOSFET Z44 to the stepper metropolis. These transistors / MOSFET provide the required current to energize the motor. One complete port of the microcontroller is used to drive both the motors in full step mode. Initially when the system is switched on all the eight lines from pin numbers 21 -28 of this port remains in high state, there by all eight transistors used as MOSFET drivers conducts and keeps all MOSFETS inputs in zero state.

IV.   89C51 MICROCONTROLLER

Fig: 6 89C51 Microcontroller

ATMEL Corporation introduces AT89C51; it is an 8-bit microcontroller. This microcontroller has 128 bytes of RAM, 4K of on-chip ROM, two timers, one serial port, and four ports of 8-bits each all on a single chip. 89C51 is basically Flash ROM version of 8051 families. 89C51 is basically a 40 pin Dual-in-package

V.   LCD INTERFACING WITH 89C51

These display units dominating seven segment displays by providing more features to the user. The LCD system can display numbers, characters, and graphics, where as seven segments LED's displays only numbers; therefore most of the engineers prefer LCD's. The data fed to the LCD remains as it is and the same will be displayed until it gets an erase signal from the controller.
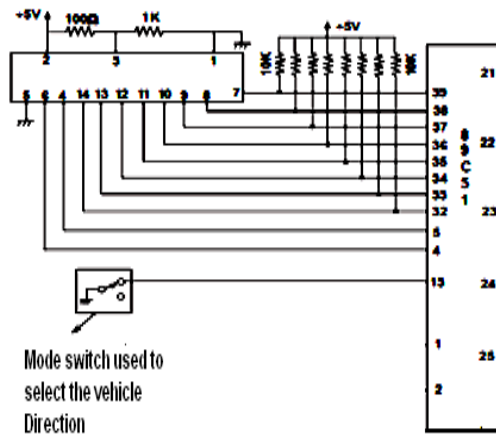

Fig: 7 LCD interfacing with 89c51

VI.   KEYBOARD INTERFACING

To interface these two devices more I/O lines are required and this controller is having 32 I/O lines, therefore this IC is best suited for digital communication systems.
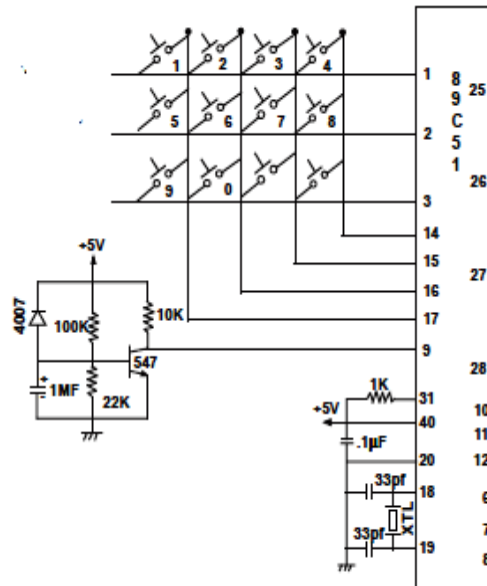
Fig: 8 keyboard interfacing 89c51 microcontroller

A keyboard which is designed with 64 keys can engage two 8 – bit ports completely, this is possible when all the keys are arranged as 8 x 8 matrix format. In this project work 32 keys are used and they are arranged as 4 x 8 matrix format and 12 I/O lines of microcontroller are engaged to detect the press key.

VII. HARDWARE DETAILS

The following are the important components used in this project work.
- ✓ 89C51 Microcontroller chip
- ✓ Z 44 POWER MOSFET
- ✓ Relay
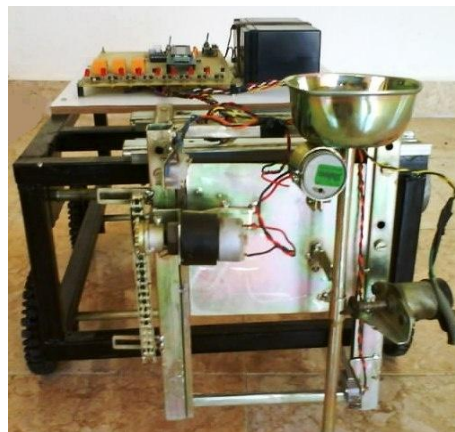- ✓ BC 547 NPN Transistor
- ✓ Voltage Regulator
- ✓ DC Motor

Fig.9 Automatic sowing machine

VIII. CONCLUSIONS

This project work titled as "Automatic Sowing machine" is designed and developed successfully. For the demonstration purpose a prototype module is constructed for live demonstration, results are found to be satisfactory. Since it is a demo module it cannot be used for real applications, but after some modifications in the mechanism, it can be converted as real working machine.

To convert as real working system, the machine should able to plant the seed at some depth in to the soil, for which some force is to be applied; therefore higher rating motors are proffered, otherwise hydraulic technology can be implemented. If the planting mechanism is widened it can be planted more seeds in one row within less time. Presently the machine operates at low speed; this speed can be increased by increasing the pulse rate produced by the microcontroller to drive the stepper motors.

Presently the machine is designed with single microcontroller unit; therefore functions are minimized, to enhance the process by implementing additional features like counting and displaying the planted seeds, to adjust the machine speed, to pore the water over planted seeds automatically, etc. can be added to the system by using more number of microcontroller units with higher rating memory powers.

IX. ACKNOWLEDGEMENTS

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