Smart Component Vending System

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***Abstract*—In educational institutions, it is quite difficult to issue the components to the students in laboratories during the rush time period. In order to overcome this scenario, the Smart Component Vending System is developed. Adjustable gripper that can perform faster, easier pick and place operation for the objects have been developed for the purpose of vending components, similar operation is performed in this Smart Component Vending System by replacing adjustable gripper with an electromagnetic lift to pick and place the component boxes. The purpose is to supply the components to the user as per the demand. Smart Component Vending System is implemented using Arduino MEGA 2560. The overall system is programmed using Arduino. IR sensor is used to detect the presence of the component box on the user desk. Geared DC motor is used to move Z-axis and 2 stepper motors are used to move X and Y axis in a required direction. In order to access each component box from the component grid, the addresses are defined by setting the coordinates of XYZ axis. As per the user input, XYZ linear motion is achieved and pick and place operation is performed.**

***Keywords*—Smart Component; XYZ Linear Motion; Pick and Place; Parallel modes of operation.**

I. INTRODUCTION

Today the development of technologies made it possible to introduce automation in all the fields. The automation process enhances the labour efficiency and allows the cutting net cost. Advancement in all the fields yields to reduction of work. Nowadays robots are increasingly being integrated into working tasks to replace humans specially to perform the repetitive task. In general, robotics can be divided into two areas, industrial and service robotics. International Federation of Robotics (IFR) defines a service robot as a robot which operates semi- or fully autonomously to perform services useful to the well-being of humans and equipment, excluding manufacturing operations. These mobile robots are currently used in many fields of applications including office, military tasks, hospital operations, dangerous environment and agriculture. Besides, there might be difficulties to the worker which must pick and place something that can affect itself.

For example, things like chemistry that cannot be picked by human and for the military such as defuse bomb that is needed for the robot to pick and place the bomb to somewhere and for user that needed robot to do pick and place item while sitting and much more. Therefore, a locomotion robot can be replaced human to do work.

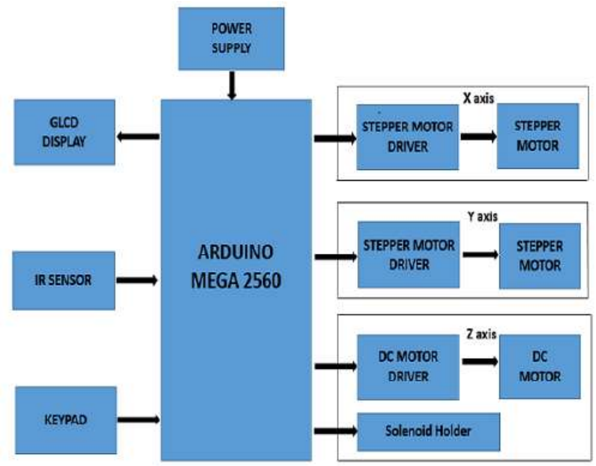


Figure 1. Block Diagram of the System

II. BLOCK DESCRIPTION

A. Block Diagram

As shown in the Figure 1, Power supply is used to provide DC voltage supply to the system. Keypad is used to give the input to the system. GLCD is used to display the given input and to display the response of the system. Arduino is the soul of the system. The overall system is programmed using Arduino. It will take the input from user and compare the input with database and find out the location of the component. Motor driver circuit will be used to drive the motors. Two telescopic slides are used for the X and Y axis are fixed to the frame. Stepper motors and DC motor will be used for the 3 axial linear motion. Sensor is used to detect the presence or absence of component box on the user desk. Solenoid holder is used to hold the box of the components that has to be pick and placed as per the user requirement.

B. Design Specifications

The smart component vending system base is a 30-inch × 30-inch piece of half an inch-thick plywood. Two 16-inch Telescopic Slides and one 10 inch Telescopic Slides are used in total for axis control. Two telescopic slides are used for the x-axis and Y- axis and 10-inch telescope is used for z-axis movement. The Y-axis slide ends are fixed to the moving part of the X-axis slides. This arrangement provides a work area of 20×20 sq. inch. The Z-axis mechanism is placed on the moving part of the Y-axis slide. This mechanism provides up and down movement with the help of rack and pinion. The rack and pinion gears used are straight teeth type, which have the tooth axis parallel to the axis of rotation. The height of Z axis from the base is 8 inch. Component grid box is designed of 15*15 inch from wooden cardboard.

Figure 2. XYZ Axis Model

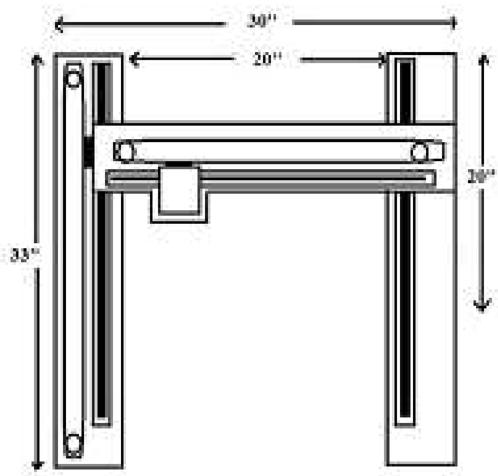


Figure 3. Top view of the System

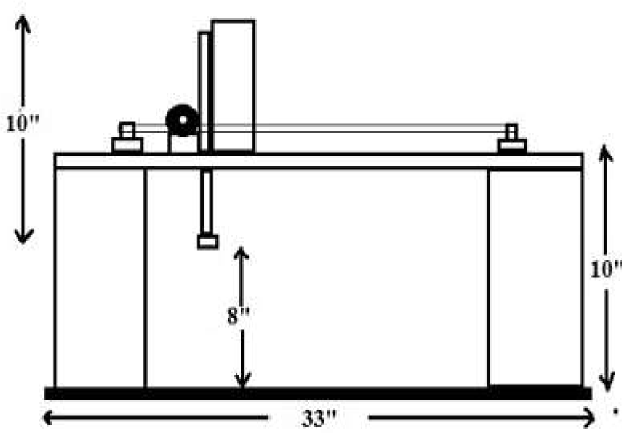


Figure 4. Side view of the System

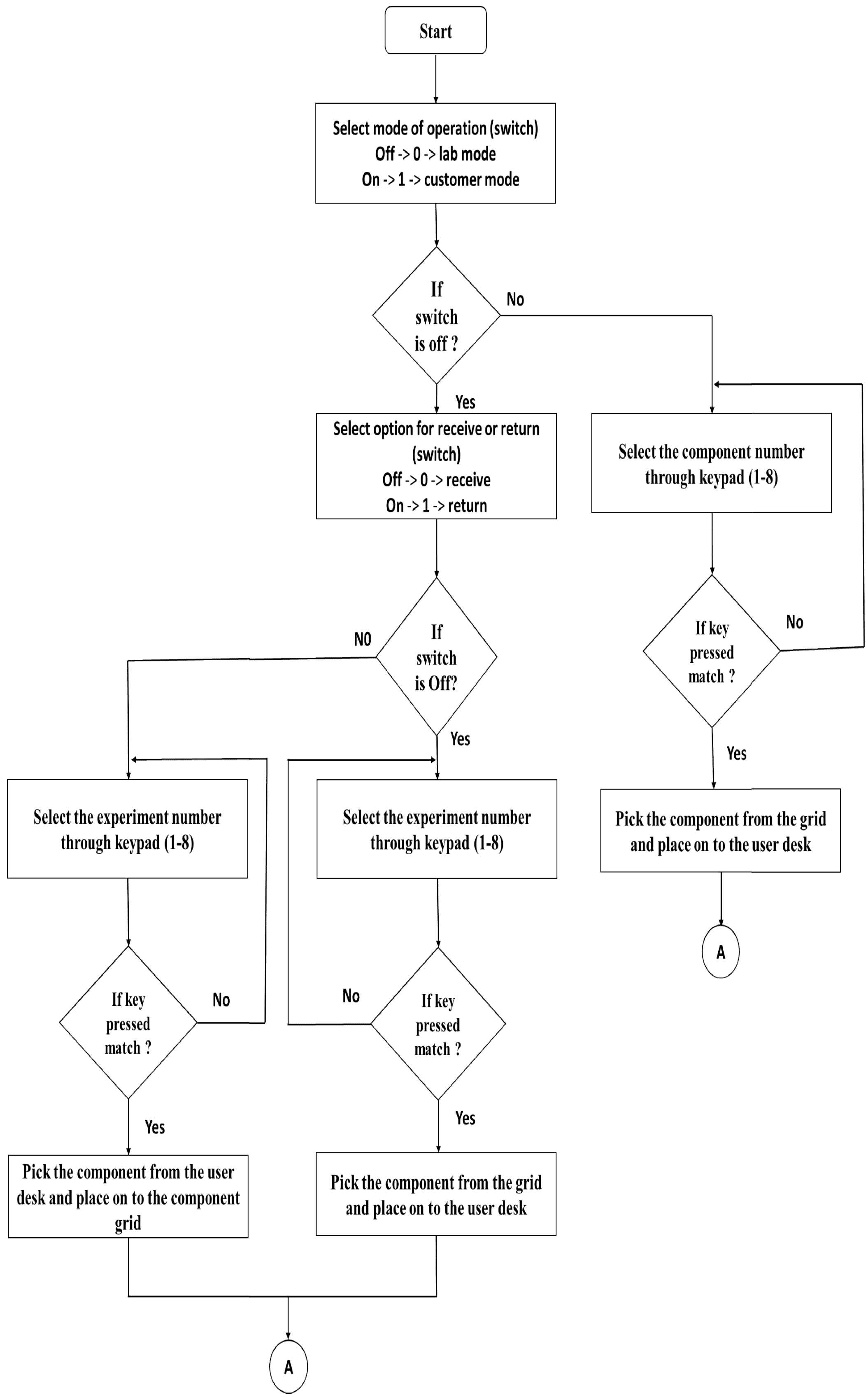
C. System Description

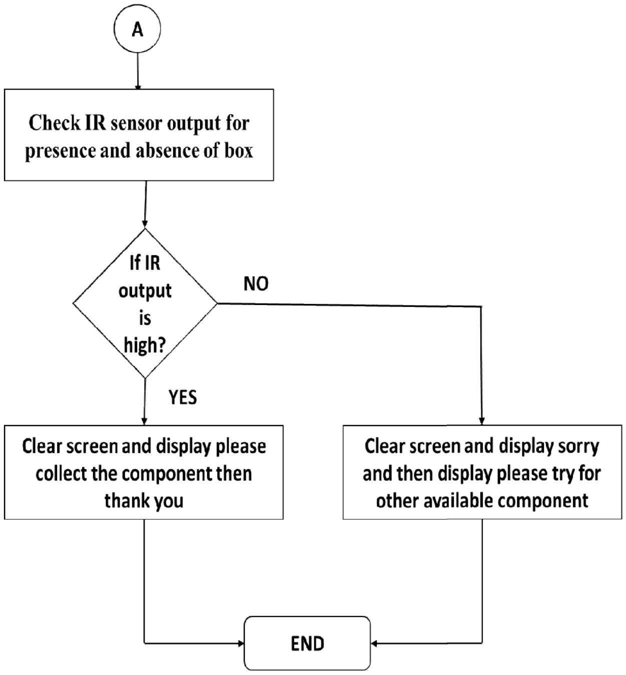
- The user can interact with the system by entering the input through keypad.
- Two Modes of operation is possible in the system.
- If the user select assistance to laboratory purpose or lab mode, then the system will display list of experiment name or experiment number; the user will enter his/her choice through keypad.
- The system then asks the user whether to vend the component to user or receive back from the user.
- On detecting experiment name/ experiment number, the system will search for the box containing components for the requested experiment or it places back the component box to its grid.
- If the entered input does not match, the system asks the user to re-enter the input.
- If the user selects assistance to customer mode, then the system will display list of component, the user will enter his/her choice through keyboard.
- On detecting component name by the system, the system will search the component and find its location.
- It turns on motors to find where it is placed and picks that component box there by placing them to the customer desk.
- If the input entered does not match, the system will ask the user to reenter the input

Figure 5. Front Panel of the system

Figure 6. Overall view of the system

D. Overall flowchart of the system


Start
Select mode of operation (switch)
Off -> 0 -> lab mode
On -> 1 -> customer mode
If switch is off ?
No
Yes
Select option for receive or return (switch)
Off -> 0 -> receive
On -> 1 -> return
Select the component number through keypad (1-8)
If switch is Off?
NO
Yes
If key pressed match ?
No
Yes
Select the experiment number through keypad (1-8)
Select the experiment number through keypad (1-8)
Pick the component from the grid and place on to the user desk
A
If key pressed match ?
No
If key pressed match ?
No
Yes
Yes
Pick the component from the user desk and place on to the component grid
Pick the component from the grid and place on to the user desk
A



III. RESULT

1. Message displayed in GLCD as shown in the figure 7 when the system turns on, the Arduino resets and program will be loaded by boot loader and executed. The system will display a welcome message

Figure 7. Welcome Message

2. The project title will be displayed after some amount of delay as shown in the figure 8

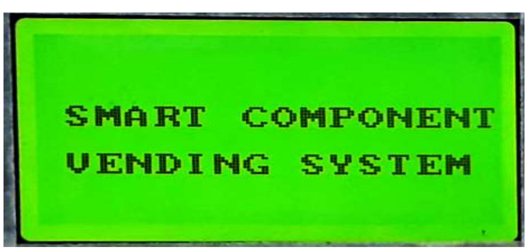


Figure 8 Display of title of the project

3. As shown in figure 9, it displays a message asking for selection of modes of operation and it will ask to select mode using switch on the panel.

Figure 9 Display of mode selection

4. If the user wants the system to work in the lab mode, it will operate in the lab mode. The system will display message that it is in the lab mode as shown in figure 10

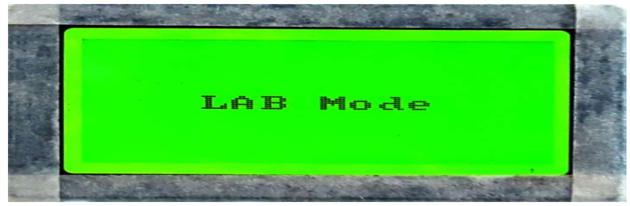


Figure 10 Display of lab mode

5. After entering into the lab mode, the system will ask for the selection of whether to receive or to return the component box by setting the switch on the panel.

Figure 11 Display of mode selection for return or receive

6. If the user has done any selection, it will show the experiments number list as shown in the figures 4.6 and 12

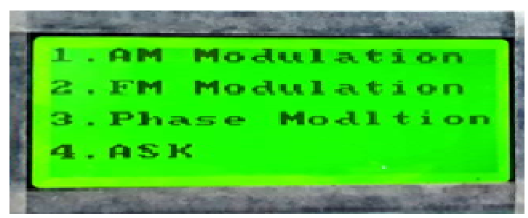


Figure 12 List of components

7. Right after the display of the list, the user has to select experiment number and should press the number in the keypad.

Figure 13 List of components

8. When the user selects an experiment number, the xyz slider will move to the particular coordinate as shown

in figure 14 and it will pick the component box of the selected experiment from the grid and it will move back to the home position.

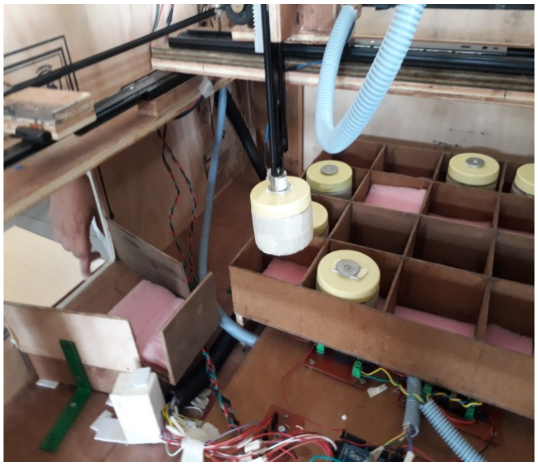


Figure 14 Picking the component box

9. After moving back to the home position, it will drop the component box on to the user desk as shown below

Figure 15 Dropping the component box at home position

10. Then the system displays the message to collect the component box followed by thank you message as shown in figures 16 and 17

Figure 16 Message display to collect the component

Figure 17 Thank you message

11. If the user has selected the return option, then after selecting experiment number slider will pick the component box from the user desk and then keep back to its related coordinates.
12. Suppose if the user selects the customer mode on the panel, it will display the message that it is in the customer mode as shown in the figure 18

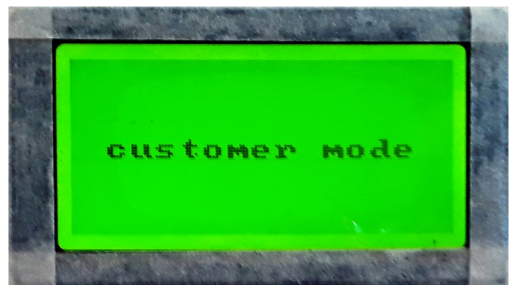


Figure 18 Display of customer mode message

13. After displaying the customer mode message, it will display the component lists as shown in figures 19 and 20

Figure 19 Display of list of component

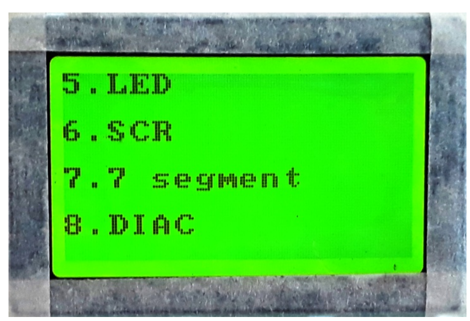


Figure 20 Display of list of component

14 User has to select the required component number from the list. Then the slider will move to the respective coordinates and pick the component box from the grid as shown in the figure 21

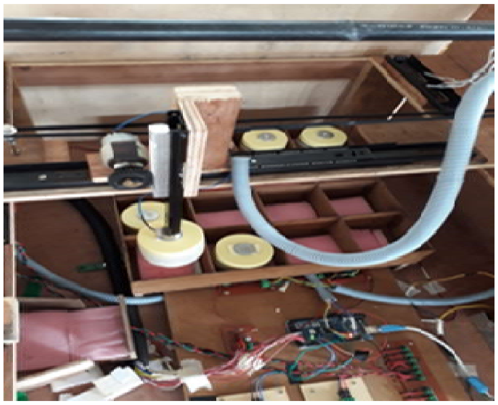


Figure 21 Picking component box from the grid

15 After picking the component, it will move back to the home position and dispend onto the user desk as shown in the figure 22

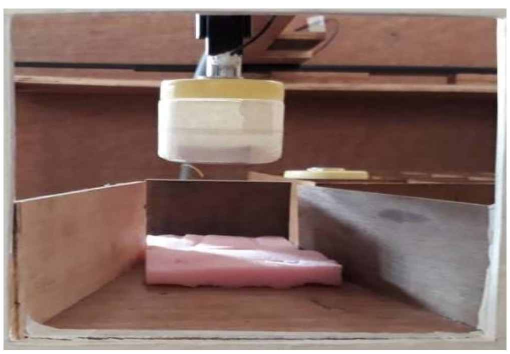


Figure 22 Dropping the component box

IV. CONCLUSION

Advancements in the technologies has brought reliability in the performance of small and large scale automatic systems. Since the robots replace the human in many tasks, the Smart Component Vending System replace a human hand in distributing work and gives the ease of operation and ensures reliability. This system provides accuracy and speed in pick and placing the component boxes onto the user desk. The system operations in both lab and customer mode are satisfied. The designed system can be installed in the pharmacy and medical shops that can replace a worker and helps to get the required tablet boxes. In the manufacturing industries, Smart Component Vending System replace component distributor and is capable of working 24 hours without getting strained.

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