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DESIGN OF UNIVERSAL CANISTER CONTROL MODULE USING ARM MICROCONTROLLER

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ABSTRACT

Canister is a protective shield used for the safe transport, storage and launch of an article. Once the article is canisterised, the canister must provide a safe environment to the article throughout its lifecycle. A Canister can be operated by three different modes namely manual, Semi-automatic and Automatic modes. In the current scenario, manual and semi-automatic modes are available whereas the automatic mode does not exist. Therefore, an attempt is made in this paper to control the canister mechanism by both automatic and partial-automatic modes. Then, the status of various interlocks of canister and article are provided to the Display system.

.***Keywords:*** *Canister, automatic, ARM microcontroller, Design*

[1] INTRODUCTION

A protective shield (canister) is used for the safe transport, storage, and launch of an article (Jochem and Willet, 1994; Brown Robert, 1962; Wallach et.al, 2001). The canister must provide a safe environment throughout the lifecycle of article, once it is canisterised. The operation of canister mechanism can be done in three modes namely, (i) manual mode which already exists and a mechanical system is used for operation (ii) Semi - automatic mode in which push buttons are used and (iii) Automatic mode, where the mechanism can be operated from the Graphical user Interface (GUI) of the Control System. At present, the automatic mode of operation does not exist.

Figure 1 shows the canister with various interlocks. The canister mechanisms include operation and sensing of the following parameters

1. Hatch/Lid : Open/Close
2. Side Support 1 : Lock/Unlock
3. Side Support 2 : Lock/Unlock
4. Article Support : Up/Down

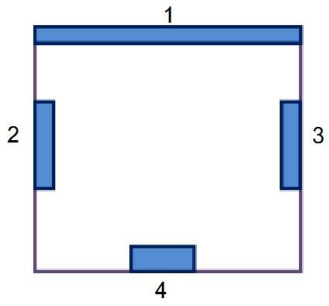

Fig.1: Canister with various interlocks

The whole system consists of Control System, Universal Canister Control System (UCCS), Display System, Universal Canister Power Module (UCPM) and Canisters. User gives the Input command from GUI of Control System and it is given to UCCS through Ethernet as a Digital Input Signal, where User Datagram Protocol (UDP) is considered for Ethernet communication. The UCCS consists of Control PCB, Input PCB and Output PCB. It also consists of Push Buttons and LED's. Push Buttons are used in Semi Automatic Mode and LED's are used in both the semi-automatic and automatic modes to indicate the status of the mechanism's whether they are opened or closed. Each canister has four mechanisms and each mechanism has two modes ie., open or close (Lock/ Unlock, Up/Down) respectively. To indicate the status of mechanisms for each canister, eight LED's and eight Push Buttons are required. The UCPM consists of contactors and motors and the display system is used to display the input received from the UCCS. The array of canisters is placed, which obeys the command from the Control PCB for the operation of mechanism. The architecture of overall system is shown in Figure 2.

[2] LITERATURE REVIEW

A. Role of canister

Canisters may be more than 20 feet long and weigh thousands of pounds depending on the article. A canister is sometimes going to be unopened for a long time period. Canisters must be weather tight, impact and drop-

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resistant. Although the canister's internal components are unique to interface with specific articles, the exterior interface of all canisters is identical. This characteristic of common exterior interface allows the placement of any article in the canister, in any location and minimizes the need for unique handling equipment (Dean Putnam, 2009; Goud et.al, 2012).

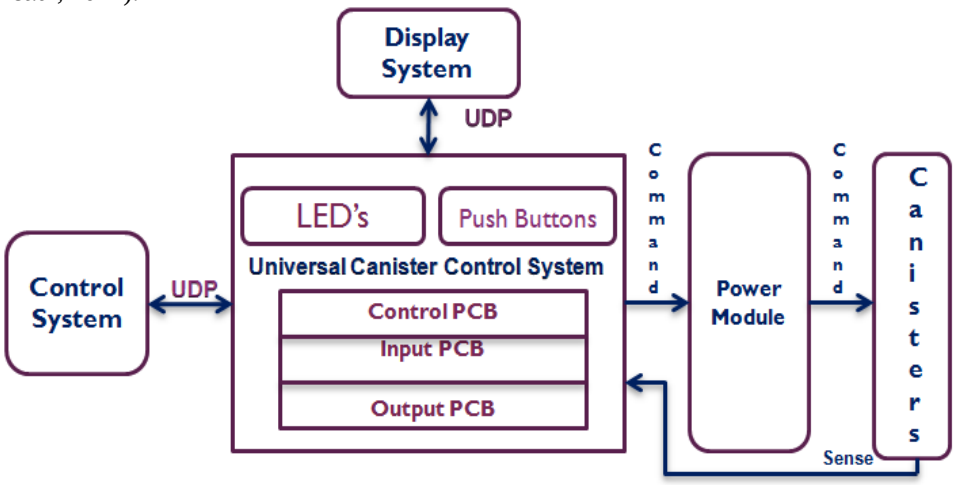

Fig 2: Architecture of Overall System

B. Manual mode of operation

Manual mode of operation consists of a Shaft, Gear Box, Mechanism and Limit Switches. Whenever the shaft is rotated from outside, it turns the gears present in the gear box. Then there consists of a mechanism which converts circular motion to linear motion and it goes to limit switches, then the hatch is opened or closed depending on the direction of rotation the shaft. Flowchart is shown in Figure 3. The user has to identify manually, whether the hatch is opened or closed.

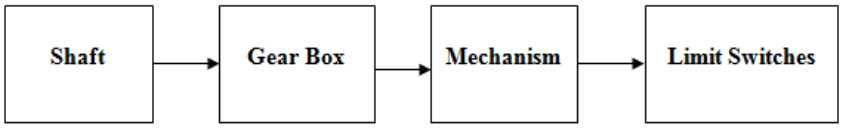

Fig 3: Flowchart for Manual mode of operation

C. Semi-Automatic mode of operation

In Semi Automatic mode of operation, push buttons are used. When push button is pressed, the signal goes to the contactor and the motor is turned and it hits the limit switch, then the status is sent to display. If the hatch/lid is in closed position and again a close push button is pressed, it does not operate. Because the voltage near limit switch is already cut. When open push button is pressed, voltage goes to the contactor from limit switch and motor turns. The door hits the limit switch and the status is changed. Depending on the input in the Semi Auto mode ON circuit, the control PCB decides whether to operate in Automatic or Semi Automatic Mode.

D. Automatic mode of operation

Input is given from the Control System to Control PCB in UCCS through Ethernet. The Control PCB gives the command to Output PCB through I2C. It gives the command to contactor in UCPM. The contactor consists of relay and coil. According to the command given, the motor is turned and when the opening/closing is occurred, it hits the limit switch. The limit switch has two contacts, one for the LED and other to sense the status. Each canister has four motors, one for opening/closing of Hatch, second for Locking/Unlocking of Article and other two for Side Supports. Figure 4 shows the flowchart for dataflow in Automatic Mode of operation.

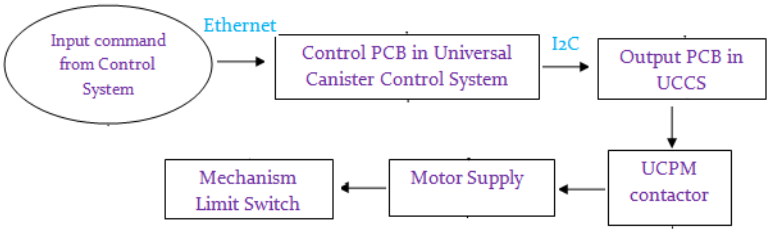

Fig 4a. Flowchart for dataflow in Automatic Mode of operation

The Sense from the limit switches is sent to Input PCB. From Input PCB, it will go to Control PCB through I2C. The Control PCB sends it to Display System through Ethernet and from there it is displayed. Flowchart for Input Sense is shown in Figure 5.

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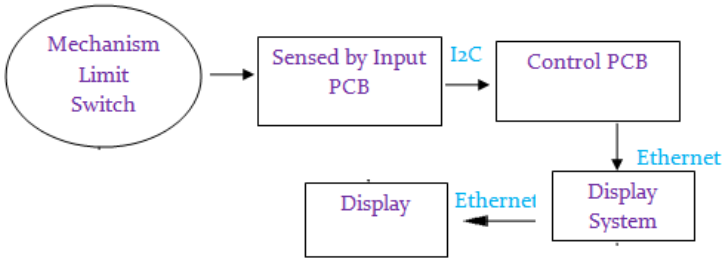

Fig 4b. Flowchart for Input Sense

[3] METHODOLOGY & RESULTS:

IMPLEMENTATION OF SEMI-AUTOMATIC MODE & AUTOMATIC MODES OF OPERATION

Limit switches, Motor Driver circuit, Stepper Motor are used along with Mbed LPC1768 ARM Cortex M3 in the implementation and the similar observations are achieved. The System level Diagram is shown in the figure 5. Push buttons are used in the Semi-automatic mode of operation and UART in the automatic mode. Only a single mechanism is implemented for the present study. Two push buttons and two limit switches are used to open and close.

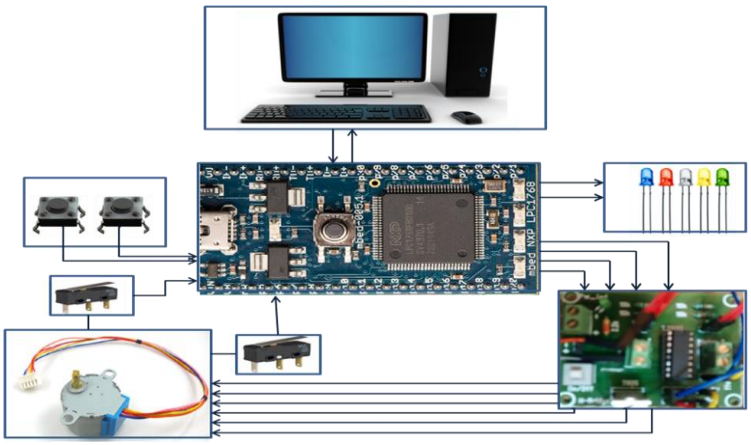

Fig 5. System level Diagram

Mbed LPC1768 is connected to computer through USB, which is used for UART Communication. Two push buttons, one for open and other for close are used. One pin of close push button is connected to Vcc and the other to pin5 of mbed board and connected to ground through a resistor. One pin of open push button is connected to Vcc and the other to pin6 of mbed board and connected to Ground through a resistor. The circuit level diagram is shown in Figure 6.

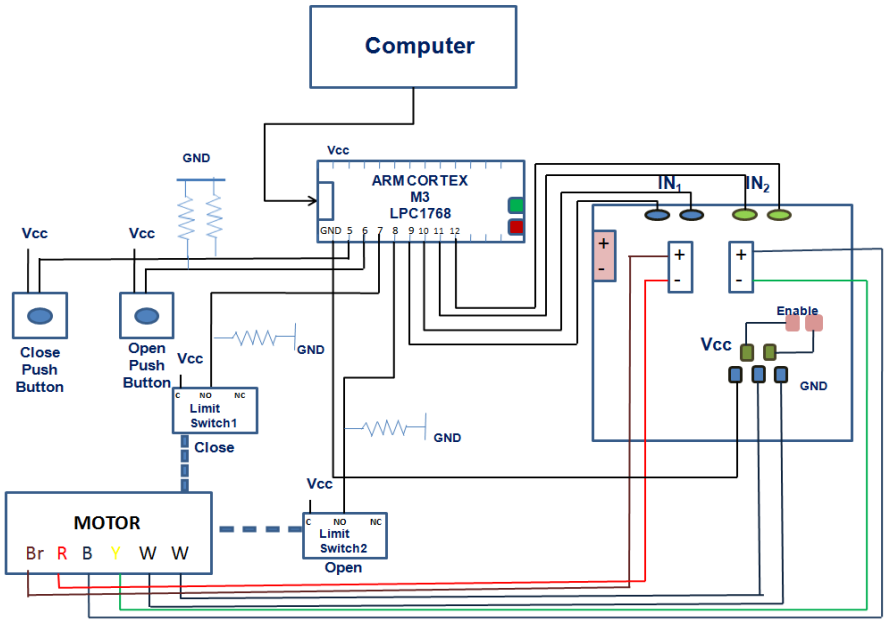

Fig 6. Circuit level Diagram

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Two limit switches are used to indicate close and open (when they are pressed). A Limit Switch has Common(C), Normally Open (NO) and Normally Close (NC) terminals. In normal condition, when switch is not pressed, C and NC are shorted and when switch is pressed, C and NO are in contact. So, Common is connected to Vcc and NO of Limit Switch1 is connected to pin 7 and connected to Ground through a resistor. In the same way, C of limit switch2 is connected to Vcc and NO is connected to pin8 of the mbed board and connected to the Ground through a resistor. Pins 9, 10, 11,12 are connected to the IN1, IN2 of motor driver circuit and four terminals of motor are connected to IN1, IN2 of the motor driver circuit and the other two are connected to ground. L293DNE IC is used in the driver circuit and in order to indicate the status, LED's on mbed board are used representing the close and open status. Command can be given from terminal using UART communication for automatic mode of operation. "C" is indicated to close and "O" is indicated to open. When "C" is given, the motor turns and hits the limit switch1. When "O" is given, the motor turns in the opposite direction and hits the limit switch2. The Status of the Limit switches and LED's are shown on the terminal. Result is shown in the figure 7a and 7b considering close as the initial position. The status of LED's are "LED CLOSE = 1" and "LED OPEN = 0". The status of Limit Switches are LS CLOSE =1 and LS OPEN = 0.

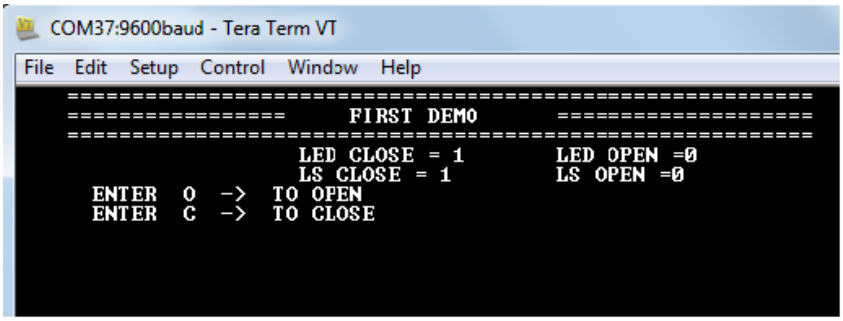

Fig 7a. Close position

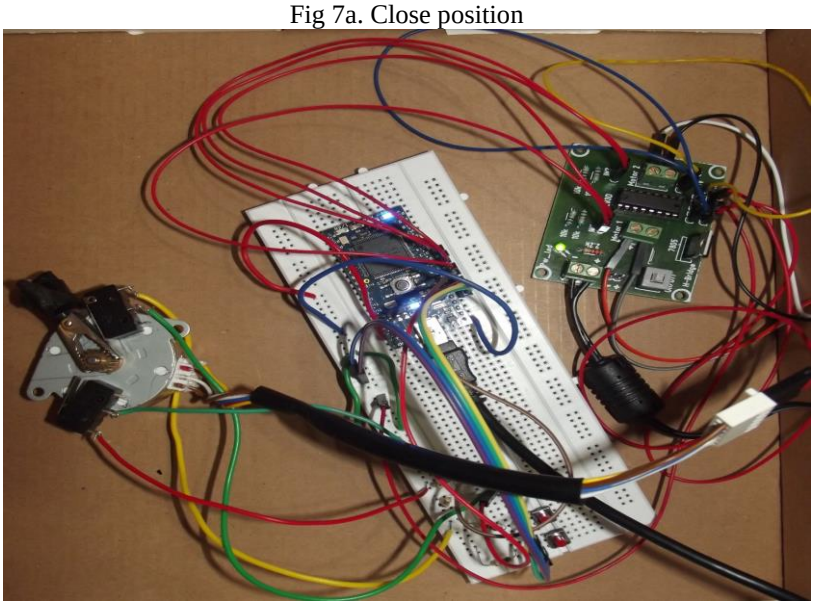

Fig 7b. Implementation of "Close Position"

Figure 8a and 8b shows the open position. The status of LED's are "LED CLOSE =0" and "LED OPEN = 1". The status of Limit Switches are "LS CLOSE = 0" and "LS OPEN = 1".

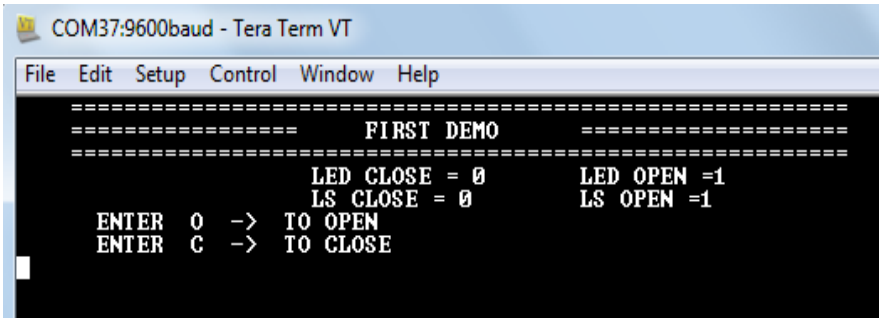

Fig 8a. Open position

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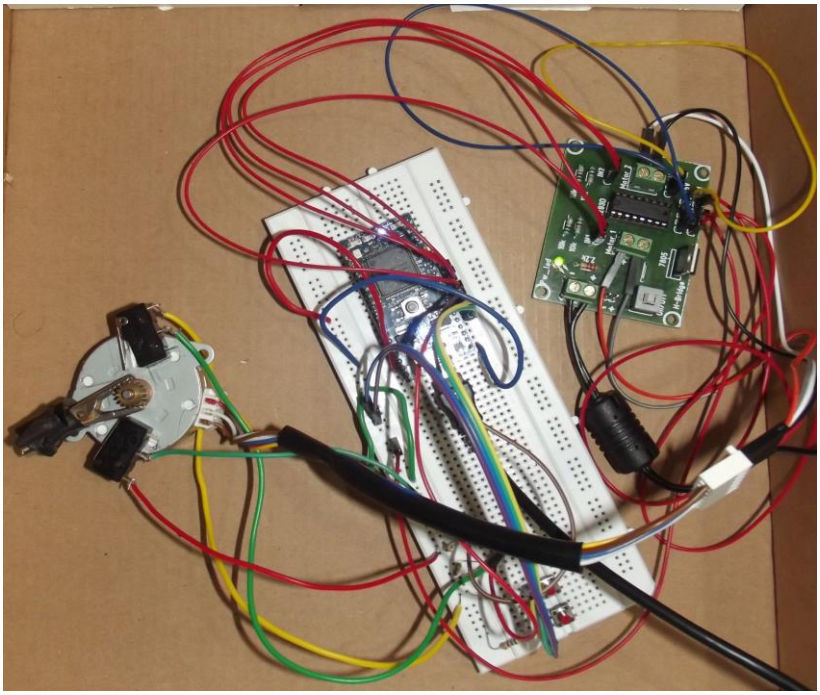

Fig 8b. Implementation of open position

CONCLUSIONS

Canister is operated by Semi-automatic and Automatic modes and the status of various interlocks of both the canister and article are provided to the Display system. The design flow of the overall system is determined. The functionality in the Auto and Semi Auto modes of operation is implemented successfully and observed results are satisfactory.

REFERENCES

[1] Bret Wallach, Harvey Koselka, David Gollaher, "Autonomous canister vaccum cleaner", US20020174506A1, 2002.
[2] Brown Robert E, "Disposal mechanism and canister construction therefor", US3027028A, City Tank Corp, March 1962.
[3] David J.Jochem and Timmy L.Willet, "Canister with lid-release control mechanism", US 5310074A, Berry Plastics Corporation, 10 May 1994
[4] Dean Putnam, "Lightweight, Low Cost Canister Shell Solution for Future Surface Ship VLS Applications", Navy SBIR 2009.2 - N092-141, NAVSEA – May 2009.
[5] Prasad Goud Alasani, Lev Belyustin,Alexander Bobrov, Shreedhar Arvind Katti,Mikhail Khomyakov, Purushotham Krishnamurthy, Sanjay Kumar, Alexander Maksichev, Valeriy Melnikov, Vladimir Nikolaev, Guruprasad Siddalingappa, Oleg Smirnov, "Hatch opening and closing mechanism for vertical ship launcher [WO 2012059934 A1]", Brahmos Aerospace Private Limited, May 10, 2012.