

Automated Personal Medicine Dispenser

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ABSTRACT

The current study delineates the design and development of an automated personal medicine dispenser that can be installed in hospitals and at homes as well. The device is designed electromechanically and is controlled by a micro-controller unit as per the user instructions. The medicines (both pills and syrups) can be manually kept in the drawers and the timer can be set by the user or attender or any health caregiver. Particular drawer opens at the set time with an audio-visual alert. The drawer closes automatically after 1 minute. External switches are also provided for manual operation of the device. This device reduces the human error of skipping their medicine doses. At hospitals, it's a tedious job for the caretakers to manage the medication timetable of every patient throughout the day. This device aids the patients and their attenders to be self-reliant for their medication services irrespective of being illiterate.

1. Introduction

In rural health-care sector, the nurse to patient ratio is very low which causes lack of proper attention and care due to overloaded responsibility [1]. The rate of human error do increases [2]. Therefore, the automated personal medicine dispenser (APMD) is proposed as a sustained solution to it. The APMD is also beneficial to reduce the human error of skipping medicine and provides an ease in operation for the illiterate attenders.

Researchers across the globe have been proposing different designs and control methods for developing such devices[3]. Many of them are costly [4], limited to particular medicine [5], lack of sensitivity [6], and available for public uses[7]. This proposed automated medicine dispenser is robust, userfriendly, cost-effective and provide personal usage. It has four drawers mechanically joined to four different DC Motors. The control of the motors were triggered by an Arduino microcontroller at particular times set by the user. Additional benefits like audio-visual alert and manual operations were also provided. The APMD can be of an close benefit for the old age people and the bed-ridden people to follow their prescribed medication time table throughout the day.

2. Requirements

Arduino Mega (Arduino, Italy), Buzzer (Think-Bots, India), blue LED (SHOPEE, India), I298N motor driver (Addax, India), 12V 60rpm DC geared motors (Generic, India), gears and pinion (size-5), DS1307 RTC module (Kitsguru,India), bread board, 12V-1A DC adapter (ADVANTech, India), Medium Density Fibre board (MDF) (12mm thickness) were used to carry out the work. Software, namely, Arduino IDE and Autodesk Fusion 360 were used in this project for control system design and prototype design, respectively.

3. Methodology

A. Prototype Development

Based on the dimensions of the mechanical components, pill size and average syrup bottle size, the APMD was

designed in Fusion 360. The system consisted of four drawers to keep the deliverable and a space in the middle for sensor and control unit storage. The software design and dimension of the APMD is given in Fig.1.

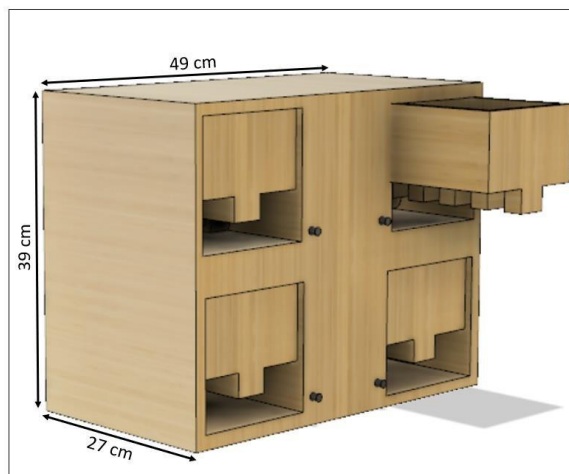


Fig.1 Dimension of an APMD

The software model was physically realized by the use of MDF. The dimensions of all the drawers are fixed and is (L x B x H) 25 cm X 10 cm X 6 cm. All the drawers were fixed with the pinion which in-turn were connected to the gear of the DC Motors. All the motors were connected to a motor driver piggybacked on the Arduino Mega. The device was painted for an aesthetic appearance. Provisions were made on the front panel to accommodate push-buttons and LED for audio-visual feedback.

B. System Integration

The APMD was integrated with electro-mechanical components, namely, DC Motor, Motor driver, Arduino Mega, RTC Module, gear pinion arrangement, push-button, LED and buzzer. The gear-pinion arrangement combined the drawers with the DC Motors connected to the motor driver.

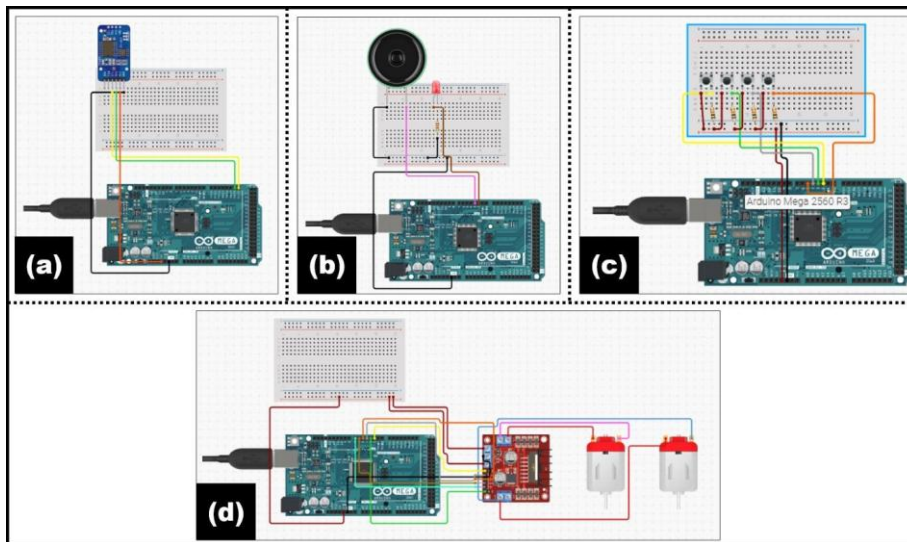


Fig.2. Sensor integration with Arduino Mega (a) Integration of RTC Module (b) Integration of LED & Buzzer (c) Integration of Push-Buttons (d) Integration of Motor Driver (L298N)

The motor driver was slotted on the Arduino Mega and was externally powered. The RTC Module was also integrated with the Arduino Mega for monitoring the time. The opening and closing of all the drawers was monitored by the RTC at particular time set by the user. Audio-visual alert service was

also implemented through buzzer and LED, respectively. The integration of RTC module, LED and buzzer, push-buttons, motor driver are given in fig 2. Fig.3 shows the block diagram of the developed system.



Fig.3 Block Diagram of the APMD

C. Control System Design

The APMD operates automatically through instructions set by the user. The control unit comprising of the combination of Arduino Mega and RTC was connected to the laptop. An Arduino sketch was uploaded to it containing the exact time of opening of each drawer. The opening of drawer was

accompanied with glowing of LED and buzzing of the buzzer. All the drawer were programmed to be closed automatically after one minute. Drawers could be closed manually through push-buttons. Fig.4. explains the detailed flow chart for working of APMD.

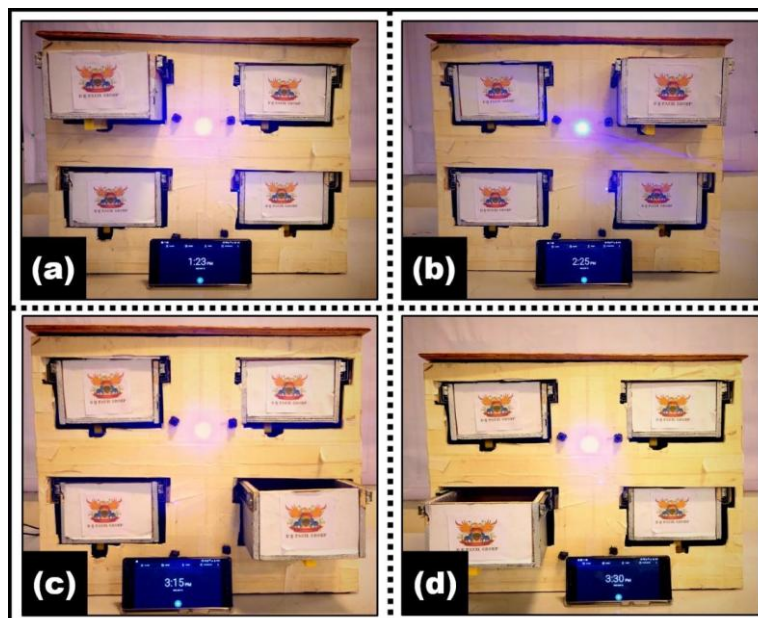


Fig.5 Operation of the APMD (a) Drawer-1 is open at 1:23 PM. (b) Drawer-2 is open at 2:25 PM (c) Drawer-3 is open at 3:15 PM. (d) Drawer-4 is open at 3:30 PM.

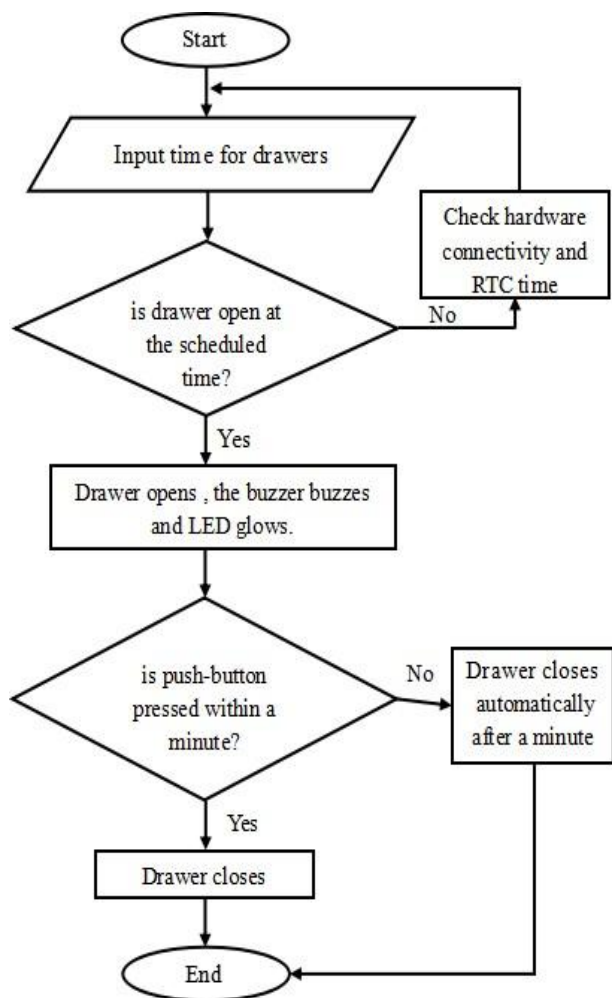


Fig.4 Flow Chart

4. Results

Based on the flow chart discussed in Fig.4, the APMD operates. At the onset, the care-taker or the attendant loaded the prescribed amount of dosage of medicine in the drawers and program the control unit as per the required time of intake. For ease of operation, the timer setup unit can be integrated as a standalone entity with the APMD. The functionality of APMD was tested by setting different time in the control unit. The scheduled opening timing for allthe drawer are given in Table I.

References

1. K. Senior, "Wanted: 2.4 million nurses, and that's just in India," ed: World Health Organization, 2010.M. Daniel and M. A. Makary, "Medical error —the third leading cause of death in the US," Bmj, vol. 353, no. i2139, p. 476636183, 2016.
2. P. K. Patel and G. Dinventory control system components," ed: Google Patents, 2014.. Butler, "Vending machine systems using standard
3. J. Miller, K. Taylor, and I. Tolmich, "Vending machine controller and system," ed: Google Patents, 1999.C. W.

TABLE I
TIMING OF OPENING OF DRAWER

DRAWER	TIME
1	1:23 PM
2	2:25 PM
2	3:15 PM
4	3:30 PM

Fig.5 shows the operation of the APMD as per the time set. The user can be aware of the opening of the drawer through an audio-visual alert created by a buzzer and LED, respectively. Each drawer opened for one minute to take the medicine and closed automatically. The drawer can be operated manually with the help of push-buttons. Manual operation breaks the intended sketch for auto-operation and triggers control signal to the Arduino Mega to direct the motor driver to rotate the motor in reverse direction. The audio-visual alert also stops during manual operation too.

5. Conclusion

The presented APMD dispenses specific medicine to the patients at the right time with an associate facility of audiovisual alert. Prolonged hospitalized, old and bedridden patients and the illiterate demographic are benefitted by this device. The health caregivers are also equally benefitted as it reduces their tedious job of managing the patients meticulously. The APMD can be used at home for providing same advantage to the patients. The device has the capability to store pills and syrups for a month. The device is designed with electromechanical combination of elements and is controlled by Arduino Mega. The time of medicine intake has to be set by the user and specific drawer dispenses the medicine at particular time. The opening and closing of drawers are controlled automatically and can also be controlled manually. The APMD provides user-friendly, low maintenance and cost-effective features.

As per necessity, drawers can be added to the APMD. The visual alert system was there to notify the deaf patients or attendants. Additional features like medicine shortage, refill alerts can be added into it. The device can be made compact with selective usage of building components and user's need.