

Daily Check-In Device

This project is a hobbyist electronics device providing a daily check-in service for seniors. It provides up to three check-in times during the day. Checking in is satisfied by pushing a button before the next scheduled check-in hour, but if that is not done, an alarm of up to four minutes is sounded. If there is still no check-in, the device sends a push notification to a designated recipient's phone. The Pushover.net service is used for that, which requires a one-time \$4.99 payment for each receiving mobile device, but there is a free 30-day trial period.

This device is not to be used for emergency medical alerts. You don't deal with medical emergencies with an Arduino hobby project. Instead, for those who live alone, it can confirm at least once a day that they are still functioning, which if not the case might go unnoticed for weeks. However, the device can also be used locally for medication or pet-feeding reminders.



From one to three daily check-in hours (on the hour) can be set in the Menu. You can check in for the next such hour in advance simply by pressing the CHECK IN button at any time. You can only check in for the next scheduled hour today, but not for later hours today, or for any hour tomorrow. However, the device can be Paused at any time, which will suspend all operations, including push notices. So you would press the Pause button before leaving home, and press it again upon returning.

If no check-in takes place before a scheduled hour, a loud alarm is sounded for up to four minutes. During that time you can still check-in by pressing the button, and everything returns to normal. Otherwise, the device connects to your 2.4GHz router, then to the Pushover.net server, and triggers a push notification to the person you've set up to receive it. Once the notification has been sent, the device goes into Pause mode, and stays there, no matter how long, until the Pause button is pressed again.

Components

The device consists of the following components:

- Housing, such as a small wooden box, 6" x 4" x 2"
- Proto-strip-perfboard laid out in the pattern of a breadboard, 4.8 x 13.4 cm
- Arduino Pro Mini - 5V 16MHz
- DS3231 real time clock, with backup coin cell
- Lolin D1 Mini for 2.4GHz wifi
- 16 x 2 LCD display with I2C
- KY-040 rotary encoder for Menu
- SFM-27-W buzzer
- Two normally-open, momentary push buttons
- Mains-powered 5V power supply with barrel plug
- Barrel jack
- N-channel mosfet
- P-channel mosfet
- 10K pot to control display backlight brightness
- Various resistors, capacitors, diode, headers

The Lolin D1 Mini uses an ESP8266 microcontroller. It is used only for wifi functions. The RTC maintains the current time of day and generates an alarm interrupt at the next check-in hour. All other functions are handled by the Arduino. The schematic diagram and more pictures can be found in separate files.

Arduino Pro Mini Software

The Arduino Pro Mini operates as a state machine. It handles interrupts from the RTC and push buttons, manages the rotary encoder Menu options, drives the display and buzzer, and powers up the D1 Mini if needed. The States of the device, as shown on the display, are as follows:

Waiting for check-in - currently waiting for check-in for the next scheduled check-in hour

Checked In - already checked in for the next scheduled check-in hour

Done for today - already checked in for the last scheduled hour today

Paused - in Pause mode until resumed

Alarm - failed check-in, sounding the buzzer

Push Sent - no response to buzzer, push notice has been sent successfully, then device Paused

Push Fail 1 - send of push notice failed - waiting one hour to try again

Push Fail 2 - push failed again - waiting one more hour for last try.

[Menu] - processing user Menu activity

The device will try again for up to two hours if the push notice cannot be sent successfully, for whatever reason. After that, it reverts to normal operation per the scheduled check-in hours.

Menu

The Menu can be accessed by pushing the rotary encoder's Menu button. Then turning the encoder knob CW or CCW lets you move between items or adjust the value of an item, and pushing the button again selects the current value, or exits. Menu items are the following:

Set date/time - Set or change the RTC to reflect the correct current date/time. You can change the year, month, day, hour and minute. Turn the knob to select one, press again and adjust the value of that field, and again to accept that value. Exit this item by pressing when "<" is flashing. RTC time will be reset only if a change has been made. You can set time exactly using time.gov.

Set check-in hours - Set one, two or three daily check-in hours. The hours must be in order, from earliest to latest. Hours may range from 7:00 AM to 11:00 PM.

Auto-adjust DST - Set whether to change the time automatically for daylight saving time. This should normally be Yes, but if Congress ever sees fit to do away with DST, this will let you disable the adjustment. Leap years will always be handled correctly through 2096.

Set Buzzer Time - Set the time in seconds the buzzer will sound after a failed check-in before trying to send the push notification. Can range from 1 to 250 seconds. Note that you can still press the Check-In button while the buzzer is sounding to abort the push notification and return to normal.

Set Quick Tries - Set the number of immediate attempts to complete the push notification. Can be one, two or three times.

One-Hour Retries - If still no success sending the push notification, this can be repeated one hour later, and even again one hour after that. The entry can be zero (no such retries), one or two.

Set Wifi and Keys - After selecting this item, you would use your computer to connect to a 2.4GHz wifi access point opened by the D1 Mini. On its web page you can change the SSID and password of your router if needed, then enter the Pushover app key, user key and group key, along with your name. That information will be used to make up the later push notice packets.

Test push to me - Send a test push notification to my phone. Make sure keys are right.

Test push to all - Send a test push notification to all members of the Pushover Group, which should include those designated to receive the notices. This might be done on the 1st of the month.

Trim RTC speed - The DS3231 has an Aging register that permits fine tuning its speed. The value can range from -128 to +127. In this program, a higher number here makes the clock run faster.

Coin cell voltage - This reports the current voltage of the RTC backup coin cell. It also shows the current value of the bandgap voltage reference of the Atmega328P, which may need to be calibrated. With a meter, you can adjust the bandgap value until the device reports the correct coin cell voltage. The resulting bandgap setting is stored in the first two bytes of the Atmega328P's EEPROM, so it can be considered to be a permanent calibration of the particular chip.

Exit Menu - Exit the Menu and return to normal operation.

Note that the first seven Menu items let you enter or change all data needed by the device without having to recompile the software.

Lolin D1 Mini Software

The D1 Mini is used to send push notifications wirelessly, which it does by sending a POST packet through your router (2.4GHz only) to the Pushover server, which responds with a code 200 if the process was completed successfully. Its wifi library is set to bypass checking the Pushover server's certificate, so certificate expirations and renewals won't require any action.

Through a Menu option, the D1 Mini can also open a wifi access point which allows you to fill in the wifi credentials and Pushover keys needed to send the notifications. All that information is saved in non-volatile memory and is unaffected by power outages.

The D1 Mini is only powered up when needed to perform one of these functions. Its power is controlled by the Arduino Pro Mini via a mosfet.

Power and Power Failure

It is strongly recommended that the 5V wall wart used to power the device be plugged into the same UPS that backs up your router and cablemodem. Then all three devices needed to send a push notification will be powered up or down together.

But since a long-term outage can still occur, the device has been designed to resume operations properly after a power failure. This is possible because the current State of the device, the three selected check-in hours, and four other settings are stored in unused registers of the DS3231 RTC, which itself is separately backed up by a coin cell. So when mains power resumes, the Pro Mini boots up and reloads that information, along with the current date/time, and resumes where it left off, adjusted for the passage of time that has taken place. States like Paused and Push Sent are preserved indefinitely across power failures.

If the power outage occurs after a check-in time has been missed, but before the push notification has been completed, that State is also preserved if the outage lasts no more than two hours. The goal is to prevent a power failure from causing a push notification to be sent that isn't warranted, or aborting the sending of a notification that is still actually needed. It's impossible to guarantee the correct decision will be made. But the device will return to normal operation after two hours, so the notification will be sent eventually at the next check-in hour if check-in is missed again..

Pushover App

Use your computer to set up an account at Pushover.net, and create an application to handle the notifications. You will get an app key and a user key, and you should also set up a group key for all those you want to be notified of a failed check-in. Then each mobile phone should install the Pushover app and create an account. The Pushover service is free, except there is a one-time fee of \$4.99 for each device that will be receiving notifications. They can pay the one-time fee, or you can pay it for them if you know their user key or the email address they used to set up the account. Then under your app you will find the option to set up a subscriber link to be sent to each phone receiving notifications, so they can sign up to receive your notices. Or you can get their user key and add it directly to your Group.

The Menu includes options to send a test notification to yourself, or to everyone in the Group. It will read:

[your name] - This is a test notice

The real notice sent if you fail to check in reads:

[your name] has failed to check in, or respond to alarms

If you are using this device for some other purpose and don't want to send push notifications, you can simply remove the Lolin D1 Mini from the circuit.

Links

For the most part, I used what I already had onhand. So I don't have links for all the parts. But here are some that may be helpful:

Wooden Box - <https://www.amazon.com/dp/B08TKD4Y83>

Buzzer - <https://www.amazon.com/dp/B08SL2HH65>

Display - <https://www.amazon.com/dp/B0BCWFB5P3>

DS3231 RTC - <https://www.ebay.com/item/401482226870?var=671154997502>