# Automatic aquarium feeder

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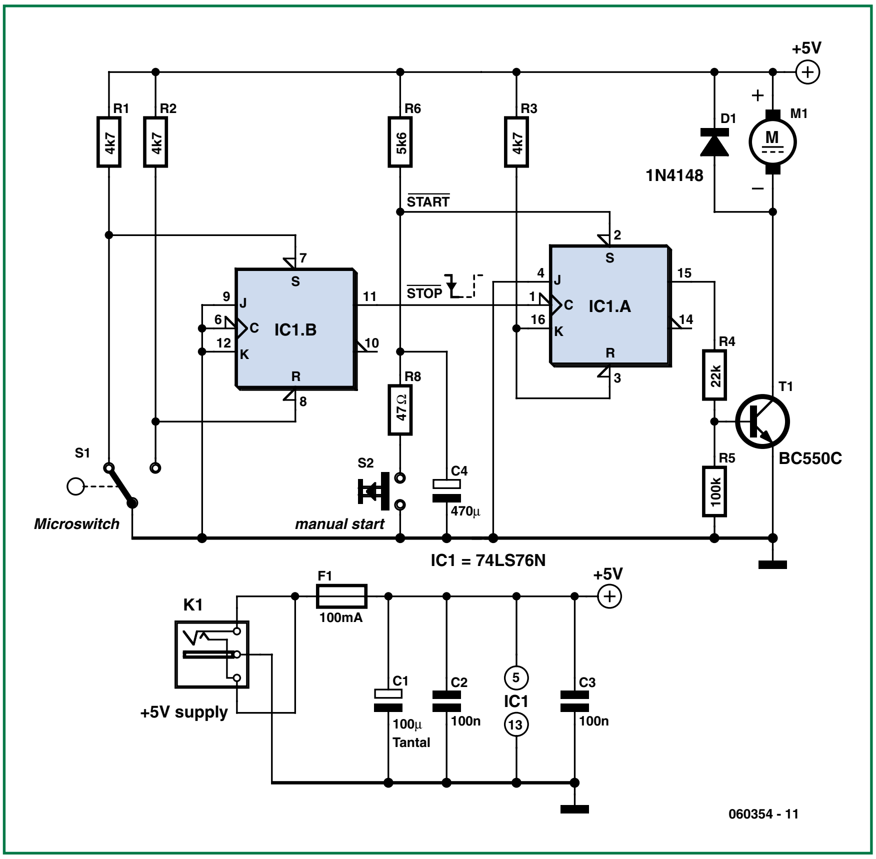
People come in all shapes and sizes and we all have our own character. You probably know people who are at their best first thing in the morning while others can only get things done when they are burning the midnight oil. The feeding habits of different fish species also show variation; some (such as catfish) are nocturnal feeders while others feed during the day. Unless your own body clock is in sync with the fish in your aquarium you will not be providing them with food when they really need it.




The solution described here is an automatic fish food dispenser. On the mechanical side the apparatus consists of an off-the-shelf DC motor and reduction gear driving an external gear train sandwiched between two plates. It is necessary for the spacing between the plates to be greater than the thickness of the fish food pellet (see illustration).
A hole in the upper plate is directly beneath a vertical tube (or magazine) which contains a stack of food pellets. The hole in the lower plate is offset and the pellets will eventually drop through here into the aquarium below. In between these holes is the final cog in the gear train which has a hole made in it between the hub and toothed edge of the wheel. The hole must be slightly bigger than the diameter of the food pellet. When the hole is beneath the column of pellets a single pellet drops down into the hole in the gearwheel. At each feed time the pellet is swept around until it passes over the hole in the lower plate where it drops through and provides a tasty snack to the fish waiting below. The prototype uses a motor/gearbox combination from Conrad Electronics (model catalogue, part no. 242535) which operates on 3 to 6 V and produces an output speed of 11 to 22 rpm. An external set of gears provides a further 10:1 reduction. The final output gear takes around 30 seconds to complete one revolution and the low operating speed helps to avoid the possibility of a pellet becoming jammed in the mechanism. The frequency of feeding is actually controlled by an external mains time-switch which switches a mains adapter powering the whole feeding mechanism. The electronics incorporated into the feeding mechanism ensures that each time the feeder is switched on it only dispenses a single food pellet. Modern time-switches can be programmed to switch several times in every 24hr period and can have an 'on' time of one minute or less. A small cam on the gear train output shaft actuates a micro-switch when a single revolution is completed. This technique of tuning the whole unit off in between switching times means that the standby current (excluding time-switch consumption) is zero. Another advantage is that each time the circuit is powered up it effectively performs a reset so it is not possible for the circuit to lock-up in an undefined state which sometimes occurs in digital circuits as a result of glitches and mains-borne interference.

The central logic element in the circuit is the TTL SN74LS76N J-K flip flop. In addition to the synchronous functions of this chip (store, set, reset and toggle) there are two asynchronous inputs namely 'preset' and 'clear' which are both active-low on this particular version of the flip flop. When power is applied to the circuit the preset input of IC1A is held low by the RC network R6 and C4 which ensures that the flip flop will always be set (Q = 1) at power up. Transistor T1 switches on and the motor begins turning. A feeding cycle can also be initiated by pressing the manual pushbutton. When the output gear wheel has completed one revolution and pushed a pellet over the hole in the lower plate a cam on the output shaft activates a micro-switch. This will ground the 'clear' input of IC1B and produce a negative going signal to the clock input of flip flop IC1A which clocks the state of the J input (0 V) through to the Q output to turn off T1 and the motor. The 'preset' and 'clear' inputs of IC1B are connected directly to the micro-switch output to provide a debounce function ensuring that a single clean clock edge is provided to IC1A. All the other inputs of IC1B related to synchronous operation are unused and tied to ground (logical 0).

Capacitors C2 and C3 should both be ceramic types and although reservoir capacitor C1 is shown as a tantalum a normal electrolytic type can be substituted. The motor together with the circuit draws around 35 mA. A 50 mA fuse (F1) is included in the supply to protect the motor and transistor should a food pellet become jammed in the mechanism and stall the motor. A more powerful motor can be used in the design but in this case it will be necessary to reduce the value of R4 to give a greater drive current and swap T1 for a power transistor. The fuse rating will also need to be beefed-up to handle the increased current.

A tip when drilling the plates is to start by making just two holes through the plates and then fitting two pins or bolts through the holes to fix the plates together before drilling the remaining holes that are common to both plates. This ensures that the holes will be properly aligned.
Although the design was developed for feeding fish it could also be adapted fairly easily for other applications that require a programmable momentary mechanical operation.

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