



# 9th International Interdisciplinary Congress on Renewable Energies, Industrial Maintenance, Mechatronics and Informatics

## Booklets



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## Title: Automatic return system for hot water recovery in the shower

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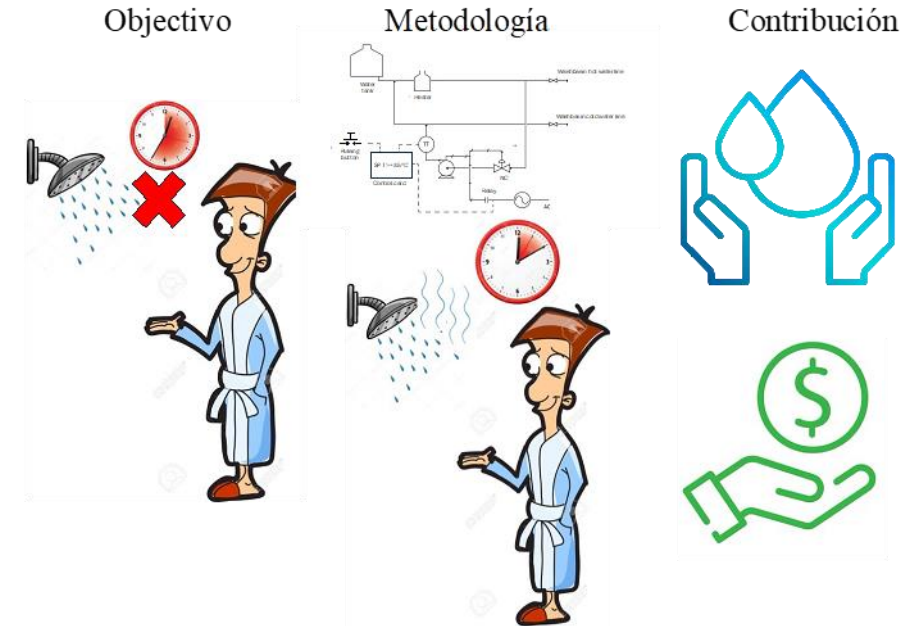
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## INTRODUCTION

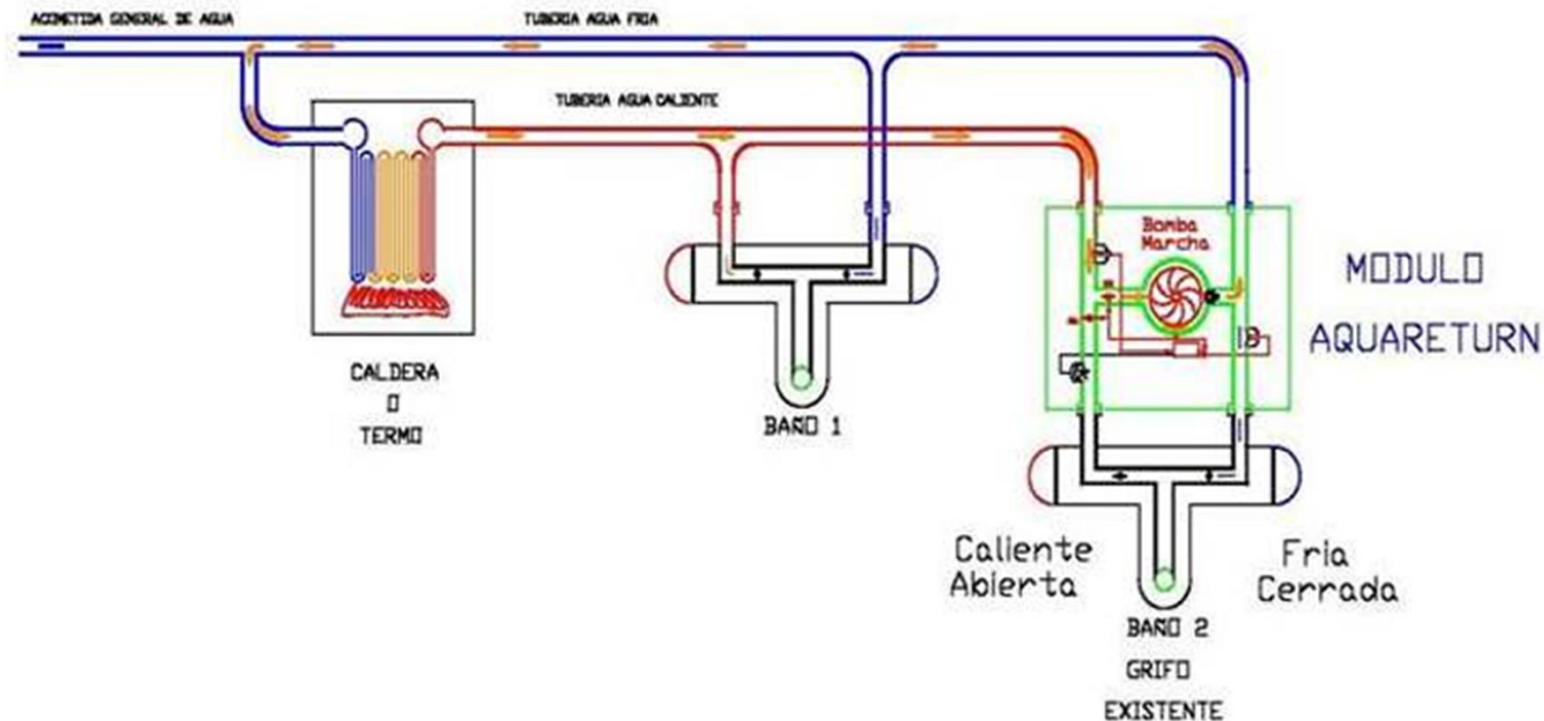
A person taking a 10 minute shower, can spend more than 200 liters, which represents a 12% of the total water consumed in the household. The shower that a person takes represents 12% of the total water consumption in a home “more than 200 liters can be used in a 10-minute bath” (Muñoz, 2018).

In addition to this, when people take a bath, they have different preferences regarding the temperature. of the water with which they bathe. Some like it to come out of the shower at a lukewarm temperature, while others prefer very hot water. Whatever the desired temperature is, it must be obtained by mixing cold water and hot water. Typically, mixing is done by adjusting the hot and cold water taps until the ideal temperature is reached. In this process, while the user waits, more than 8 liters are spent to get the water to a comfortable temperature



## METHODOLOGY

This work is inspired by the operation of the AquaReturn® commercial products and the NESS® Technology Bypass Module. Applying heat transfer principles, as well as instrumentation and process control system.

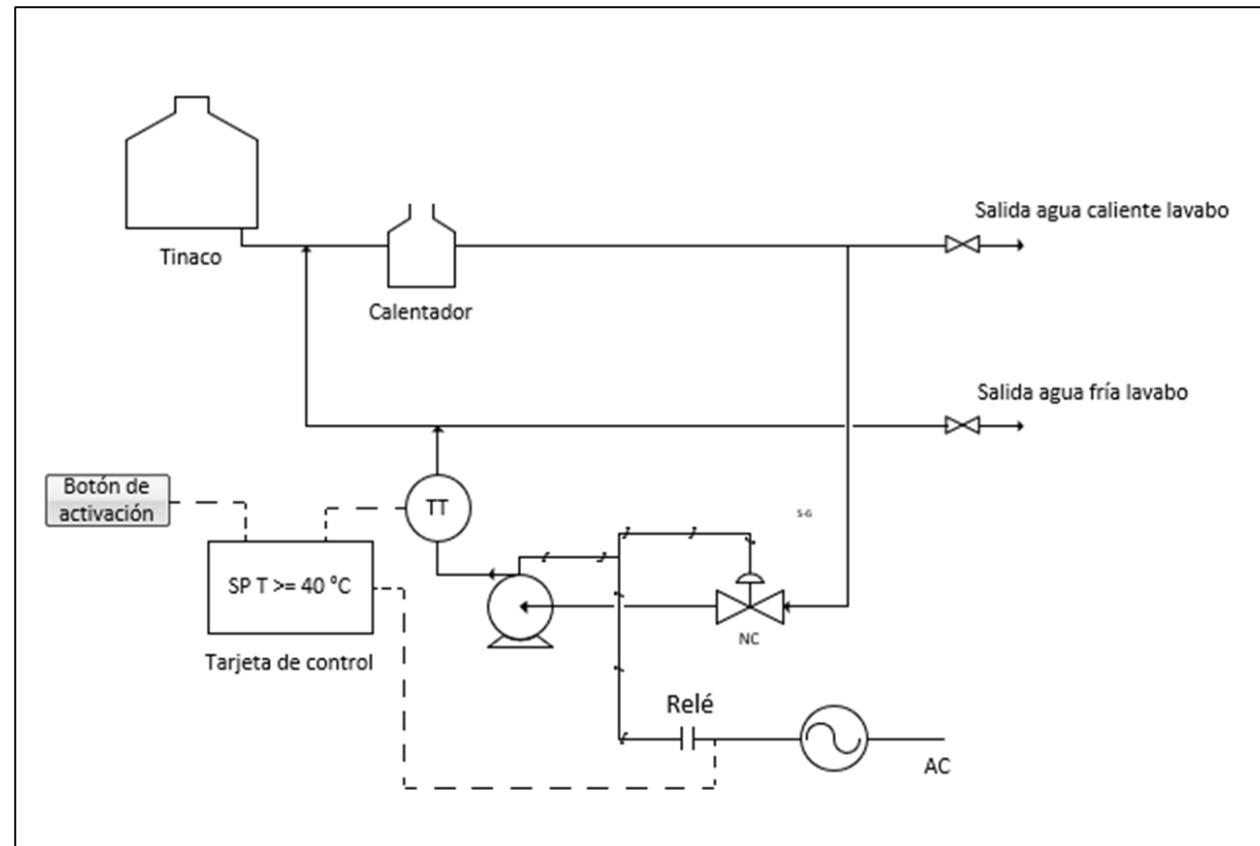


Taken from: (Aquareturn, S. L., 2015)

## METHODOLOGY



# RESULTS



Prototype

```
#include "max6675.h"
```

```
int ktcSO = 8;
int ktcCS = 9;
int ktcCLK = 10;
int temp;
int setpoint;
```

```
MAX6675 ktc(ktcCLK,
ktcCS, ktcSO);
```

```
void setup() {
  pinMode(7,
INPUT_PULLUP);
  pinMode(13, OUTPUT);
  Serial.begin(9600);
  setpoint = 35; //
Temperatura de Set Point
  digitalWrite(13, LOW);
}
{
```

```
void loop()
```

```
{
```

```
int estadoBoton = digitalRead(7);
```

```
if(estadoBoton == 0)
```

```
}
```

```
Serial.println ("Iniciando Secuencia de Recirculación");
delay (200);
```

```
do
```

```
{
```

```
recirculacion();
```

```
} while (temp < setpoint);
```

```
}
```

```
}
```

```
void recirculacion(){
```

```
Serial.println ("Recirculando");
```

```
temp = ktc.readCelsius();
Serial.print("Temp:°C ");
Serial.println(temp);
```

```
if (temp < setpoint)
```

```
{
```

```
digitalWrite(13, HIGH);
Serial.println ("Bomba funcionando");
delay(500);
}
```

```
else
```

```
{
```

```
digitalWrite(13, LOW);
Serial.println ("Bomba apagada");
Serial.print ("Temp >= ");
Serial.print (temp);
Serial.println (" °C");
```

```
}
```

```
}
```



## ANNEXES

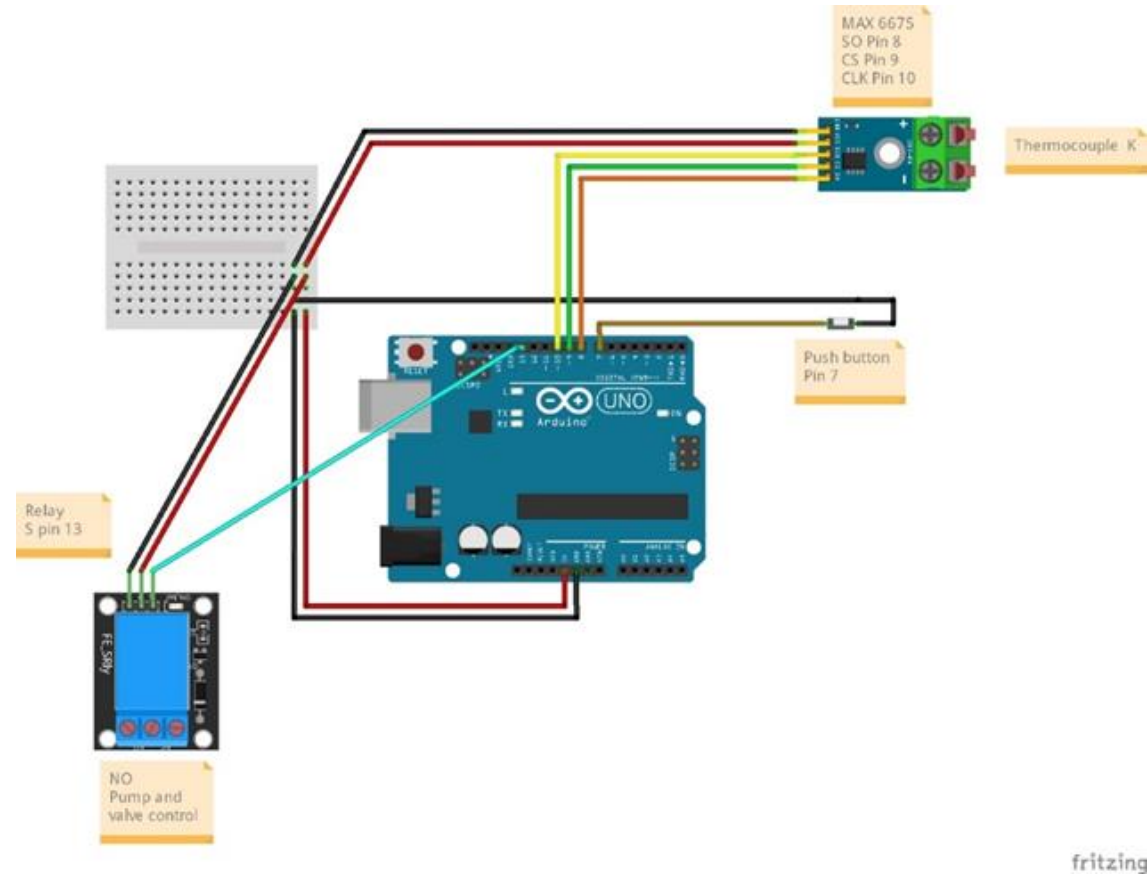


Figure 1. Connection diagram to the Arduino Uno®.



## CONCLUSIONS

1. A system for recovering hot water that is normally wasted while waiting for the water to reach the desired temperature, was built and installed in a house in the middle of the NS of the state of Mexico., according to Tthe results of this work, show a viable alternative is offered to reduce water waste.
2. According to our estimates, if all the water that is normally wasted while waiting for the water to reach the desired temperature were recovered in all the houses in the lower and middle NS of the municipalities of the State of Mexico, between around 50 and or 60 million liters would be saved daily, a quantity sufficient to supply half a million people, that is, the equivalent of covering the water needs of the municipality of Nicolás Romero, State of Mexico, for 2 days. It is worth mentioning that the prototype built can be installed in solar heaters as well as gas, electrical or other kind of heaters.
3. This work contributes to the development of prototypes that can reduce water use. We consider that it has the potential to be an adequate base in the development of multidisciplinary integrative projects in schools with educational models based on competencies, and it can also serve as a trigger for the development of Social and Solidarity Economy (SSE).

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