

Design and Development of a Mechatronic Water Saving System Applied to Conventional Faucets

Ahmed Kchok

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the Master Degree in Innovation in Products and Processes

Supervisor

Prof. Joao paulo Coelho

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Dedication

I dedicate this work to everybody that helped me to finish this project. Specially to my parents, Hela Dridi and Adel Kchok, my grandmother Souad Dridi and my siblings, Mohamed and Omar,

Acknowledgement

I want to thank all the persons that have contributed and been involved in my project in order to accomplish it successfully Especially my Professor and Mentor Joao Paulo Coelho who provided me knowledge and was always there to answer my questions.

I also wants to thank Professor Ana Isabel Pereira and Professor Vera Ferro Lebre for their constant support along the project.

I want also to thank my Colleague Thadeu Brito who helped me multiple times.

Willing to close this dedication, I have the honour to devote this part of my work for my parents, those who were, are and will always be on my side for the best and the wo

Abstract

This document describes all procedures associated to the development of an innovative product in the context of a master's degree. The study takes place according to three pillars: statistics, conception and management.

In places such as north Africa and middle Asia, water is very scarce as the statistics will disclose. Although this fact, people are burdened by a high cost of such resource and are constantly seeking to save water. Taking these into consideration, the aim of this dissertation is to study the creation of an innovative device that detects and controls the flowing of water from STL faucets.

Specifically, the design was developed using the SolidWorks software and taking into consideration the design constants such as the size and to fit it into a common commercial water tap.

The electronic circuit is based on infra-red sensor's treated via Arduino uno's ATmega328P micro controller. The power is provided by a 12 volt battery and regulated by DC-DC converters.

The document ends with a study of a possible commercialisation of the developed solution as a product by providing both business and financial plan.

Resumo

Este documento descreve todos os procedimentos associados ao Produto inovador desenvolvido mergulhando o mestrado em um estudo de três pilares: estatística, concepção e gestão.

Em lugares como o norte da África e a Ásia central, a água é muito escassa, conforme revelam as próximas estatísticas. Apesar disso, as pessoas estão sobrecarregadas com o alto custo desse recurso e estão constantemente buscando economizar água. Levando isso em consideração, o objetivo desta dissertação é estudar a possível criação de uma máquina inovadora que detecte e controle o fluxo de água das torneiras STL, tanto quanto reduzindo a energia relacionada como calor e eletricidade. O trabalho contém etapas de tentativas e experimentações feitas até chegar ao resultado sugerido.

Concretamente, a parte do design foi desenvolvida através do software SolidWorks tendo em consideração os materiais que melhor respondem à necessidade, as dimensões evitando qualquer volume e adaptando-se à maioria das cobiçadas torneiras de água.

O circuito eletrônico baseado nas entradas do sensor infravermelho tratadas através do microcontrolador ATmega328P do Arduino uno com saídas adequadas para conversores DC-DC boost e alimentado por uma bateria de 12 volts.

O documento finaliza com um estudo de uma possível introdução da solução desenvolvida como um produto, assim, a ideia de comercialização apoiada no estabelecimento de um plano de negócios e financeiro.

Essa perspectiva pode ser melhorada ainda mais com o desenvolvimento de dispositivos menores e mais baratos, fornecendo componentes filhotes, criados de forma mais adequada para esse fim. O mesmo pode ser feito para os sensores, ou seja, a possibilidade de uma máquina sem fio pode ser uma melhoria significativa.

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List of Symbols and Abbreviations

PB: Payback

EPA: Environmental protection agency

HC-SR 04 : Ultrasonic sensor

SLT : Single lever tap

TMV : Thermostatic Mixer Valve

FCT: Science and technology foundation.

IC: Internal circuit

IR: Infrared

LED: Light-Emitting Diode

PCB: Printed circuit board

TMV: Thermo-Mixer Valve

Chapter 1. Introduction

Through the last century with the advent of integrated circuits, the borders of engineering disciplines such as electronic and mechanical engineering have become fluid and fuzzy.

Mechatronic systems are defined as the synergistic combination of precision mechanical, electronic, control, and systems engineering, in the design of products and manufacturing processes. Understanding this synergy between disciplines makes us better communicators, able to work in cross-disciplines and deploy it at the service of development and features enhancement.

1.1. Context and motivation

As we know drinking water is becoming more and more scarce in all continents but the most affected places by this matter are Africa and the centre of Asia. The sub-Saharan Africa includes 75% of inhabitants that don't have access to safe drinking water, followed by the 42% of population in the centre and South Asia which struggle to save water. 23% of people in Northern Africa and Western Asia are still concerned by this water crisis.

Federal legislation passed in 1992 (EPAAct) requires that all U.S. plumbing manufacturers and importers meet the following water-efficiency standards for new fixtures: showerheads 9.5 litres per minute; and faucets 9.5 litres per minute with more water-intensive fixtures, low-flow faucets and sensors are achieving water savings. Newer low-flow faucet technologies include: metered valve faucets that deliver a preset amount of water and then automatically shut off (the federal standard for this fixture type is 0.25 gallons per cycle); self-closing faucets that are spring-loaded to shut off the faucet a few seconds after the user turns it on; and ultrasonic and infrared sensor faucets that automatically activate the faucet when hands are detected beneath it and automatically shut off when hands are detected beneath it.

On the other hand, there is a strong legislative basis in the EU for long-term integrated water management, including frameworks for the application of water pricing (e.g. tariffs) and non-tariff measures (e.g. water saving devices, education and awareness campaigns) for more efficient water use.

For that, non-touch water taps, also called sensor-activated faucets with TMVs, have been gradually introduced into private and public hospital facilities to prevent patients from risk of acquiring infection or transferring infection during surgical procedures by touching contaminated taps. These taps work only when the hands are put in front of a magnetic/sensor valve which causes water to flow out and, when hands are removed, the water flow to stop. The presence of a TMV permits the flushing of water through a single pipeline at a fixed temperature (generally about 36 °C).[2]

1.2. Objectives

The focus of the study is to create a water tap controller to reduce water waste and study the market viability of the product. In this frame we will focus on:

- Analysing the demand of the market and the problem for which we can add value in order to implement as first step prototype.
- Studying the mechanical aspects in term of design, material, dimensions.
- Studying the electronic circuit that will fit the functions required to respond the context of its purpose.
- Consider the reactions of real eventual clients in the concern and their expectations.

To fulfil these, we can design the device using different tools responding to the challenge set by the conclusion made in the market study of the topic. Finally, we will be able to present a minimum viable product insuring the proper function of the wished paradigm.

1.3. Document Structure

After this framing contextualisation subject of this first chapter, we would like to specify that the chapter 2 will start from a short description of the related work that will be presented thereby it will relate as next a few of historical background succeeded by relevance of art-pieces from the field.

Chapter 2, discusses the relevant related academic research and a possible commercial approach to integrate the product in the house appliance's market. The first section highlights an overview through the related work then a brief definition of the automated water taps with a listed of a popular manufacturer of automated water taps as potential direct and indirect competitors.

Then a description of the steps through the which we come to conceive the current device.

In the third chapter the suggested system is described through its functions and components used based on the data sheets but the outcomes of previously designed structures and designs are shown in the fourth chapter. It also includes the software program used to create simulations to test the work's concepts and implementation decisions.

The fifth chapter focuses on defining the work breakdown structure, activities, logical relationships, durations, and direct costs for projects. Project planning terminology will be given and analysed. The project network is shown using many graphical ways, such as activity on arrow.

On the chapter six we will outline the entire project, including a conclusion and suggestions for future research in the same topic.

1.4. Overview of water saving technologies

For decades, urban and industrial development have consumed a considerable amount of water resources, and the average water utilization rate is quite poor, resulting in a large proportion of water resources being spent.

Technologies are adapted and applied to modern residential buildings in order to make people's lives more energy-efficient and friendly to the environment in different fields such as Agriculture, industry, and urban living water can all benefit from water-saving methods.

There isn't a clear line between these two. The most important thing is to raise public awareness about the importance of conserving water. Only when individuals come together, then they will be able to achieve their intends and modify their living habits and enhance their degree of consciousness.

Now that water waste is produced in residential buildings, it can also be recycled and extensively utilised. Sewage can be converted into pure water.

Water storage equipment can be installed in modern homes to help reduce water wastage.

1.5. Statistics of water savings

Due to the ever-increasing demand of water by a rapid population growth and the climate change the water providing becomes more and more difficult because of:

- Limited freshwater resources
- High resources development cost

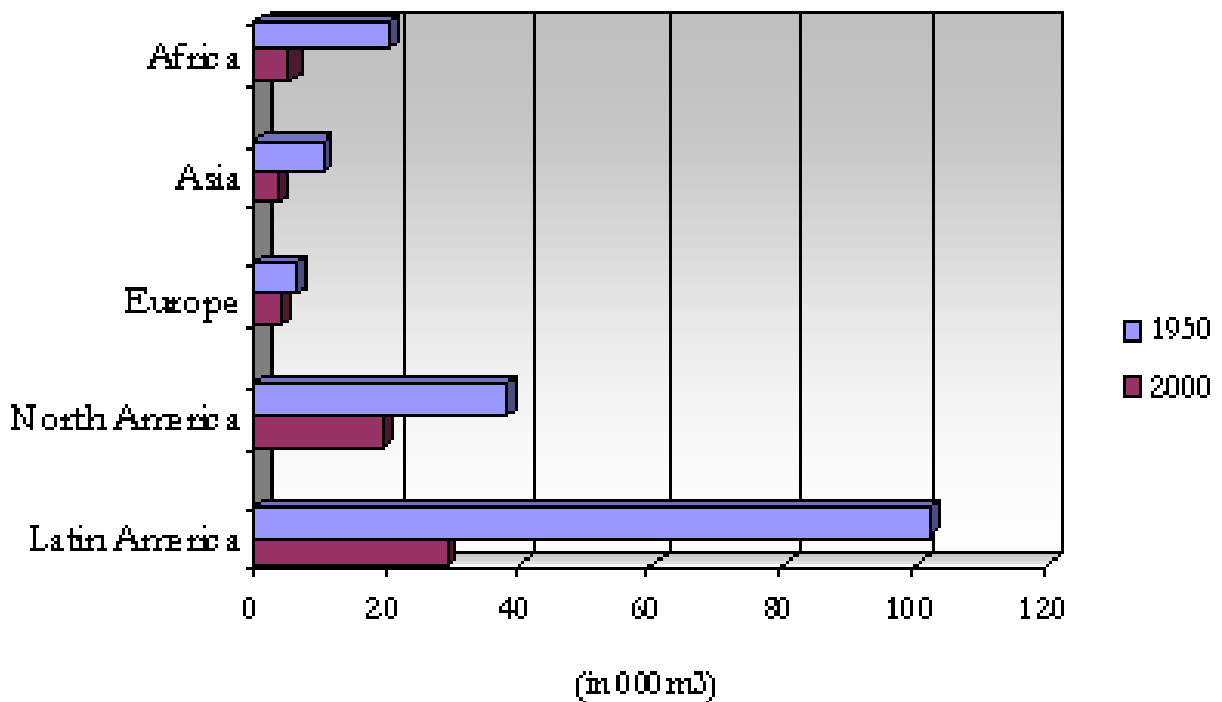


Figure 1: Availability of freshwater by region

(Source: Dr F.A Memon & Prof D Butler, 2003, workshop on water Demand Management)

These statistics show that Europe and Asia have a low availability of fresh water by region with means the emergency of saving water from waste.

Many water saving technologies were made in order to solve the problem and respond the need the main problem was the campaigns aimed at educating people to reduce consumption have generally failed to achieve significant change in consumer's behaviour.

A public awareness campaign, costing about US \$ 120,000, lunched for 8000 houses in southeast region in the UK concluded:

“Persuasion by advertising can have little effect while there is no general public recognition of the importance of water resources.” [3].

Thus, we must make long term water resources saving by the technology development for a concrete assumption rather than relying on high expectation that consumer habits will change and consumption will decline.

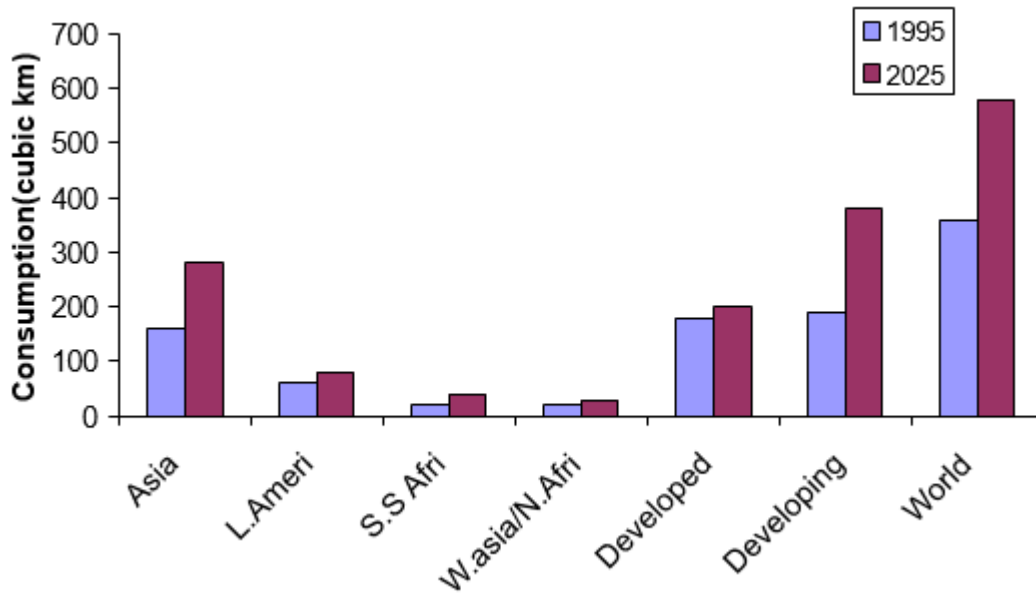


Figure 2: non-irrigation water consumption by region

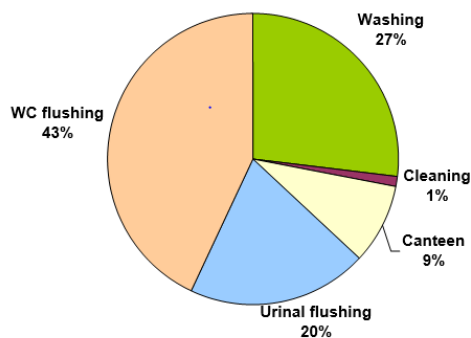


Figure 3: Water use by micro-component



Figure 4: Water use by micro-components

(Source: Dr F.A Memon & Prof D Butler, 2003, workshop on water Demand Management)

Figure 3 shows that the overwhelming majority of the water uses are the WC and for washing which gives the idea to develop domestic products seeking to save water for an optimised usage.

Figure 4 we have a more precise statistic at households' level and for this we have localized the Toilets as the household in which the biggest water waste is.

1.6. The history of water taps

The taps, as we know it today, arose in the Roman empire, in the house of the Roman nobility they already had taps in the first century, and pipes for the water supply. In the final part there was a rudimentary tap [5].

Faucets have become a central element in American culture. They can now be found at places other than airports and other institutions, such as restaurants, hotels, shopping and residential homes [5].

The Roman taps consist of a hollow bronze cylinder with two pipes attached to it halfway and at aquae angles to its length into the cylinder a second bronze cylinder, the insert, is fitted; it has two perforations that correspond with the attached pipes Fig 1. Into the two pipes the lead water conducts, the fistulae, were soldered. The insert can be turned inside the cylinder by means of a large size handle that is usually equipped with a square opening, to close and open the tap at quarter turns. The outer cylinder is closed off at its lower end with a cap soldered onto it. For water tightness the insert should fit closely into the cylinder, resulting to some extent in friction between insert and cylinder, so that the taps could not be turned easily with the fingers [6].



Figure 3: Roman water tap

(Source: BABESCH FONDATION (2017). 'Roman Taps and two Paradigms')

While people have had control over water since the stone age when they began digging wells, contemporary plumbing and taps have their roots in Ancient Rome. With a population of half a million to a million people, Ancient Rome's government aspired to provide a direct water supply to its citizens. This was a system of canals and aqueducts that were used to direct and store water. Water was delivered into public baths and certain private dwellings via lead pipes that terminated in brass valves. Surprisingly, ancient Roman taps employed a mechanism that is still used today in ball valves.

The water and sewage systems in deteriorated dramatically during the Middle Ages. Barbarian invasions, which damaged several Roman aqueducts, further contributed to the degradation. The major result of all these events was a considerable deterioration in sanitary standards. Despite the terrible period for healthcare, the use of the tap did not cease due to monastic habits. The shape of taps, on the other hand, was drastically altered. However, we had to wait until the nineteenth century to discover the concept of modern bath taps, which has forever changed people's life. This invention

served as a springboard for further research into the ability of modifying the water jet, led by Thomas Grill, an English merchant who designed the tap spout aerator nozzle. Residential water consumption, motivation for conserving water and the continuing tragedy of the commons. *Environmental Management*, 30 (2002), pp. 527 with female thread, which allows for water flow adjustment, a fact that most people are unaware of [1].

As shown in the fig 6 the medieval taps and stopcock, like their Roman forerunners works by means of a rotating plug basically it consists of a cylindrical plug 'key' that rotates in a circular socket fixed to the pipe.



Figure 4: Medieval taps

(Source: BABESCH FOUNDATION (2017). 'Roman Taps and two Paradigms')

The plug have a horizontal hole aligned with the bore of the pipe. The water was cut off by giving the plug a quarter turn, so that the hole was crosswise to the flow some medieval taps were designed so that the water flowed directly through the horizontal hole in the otherwise solid plug and out a spout on the other side. In other taps the perforation was more complex.

Upon entering the cylinder, the hole made a vertical turn so that the water either discharged upward out the top of a hollow handle or down out the base of the cylinder [7].

After the discovery of "threading," the history of the tap has continued over the years, with another significant event being the debut of the ceramic disk single-lever mixer. This word refers to the water tap that most people turn on and off in their homes nowadays. It was invented in the second half of the 1970s and then released onto the market. The tap's growth is far from over, and there will almost probably be more advancements in the not-too-distant future. Another conviction is that this commonplace object will continue to play a larger role in our daily lives than ever before.

Automatic faucets were invented in the 1950s, but they were not commercially available until the late 1980s, when they were first seen (by the general public) in airport restrooms. According to legend, O'Hare Airport was the first to implement the new technology. Automatic Faucets, also known as Electronic Faucets, Sensor Faucets, Hands Free Faucets, Touch-less Faucets and even Infrared Water conservation isn't a new concept, but new forces are causing commercial property owners to pay more attention to it. Facility executives and homeowners must find creative ways to preserve water when water resources become scarce. The ATT-1103, a battery-powered tap with an infrared sensor and manual control, has been introduced by Auto-taps for domestic use.

The need for technical assistance was a recurring theme at the workshop, with several examples and strategies emphasized. Roberson noted that technical assistance is important for small communities, because they are never going to be able to have all the resources of large communities. The importance of the EPA's funding of technical assistance programs was discussed. Kricun noted that EPA's national peer-to-peer initiative for water treatment systems encourages hub utilities in each state to help under-resourced and lower-capacity utilities. Some participants called specifically for peer-to-peer initiatives to be expanded [8].

The major hurdles facing entrepreneurs who want to develop assertive technologies for people that improve needs or interest in automation is funding. While start-ups enjoy a great number of investment opportunities for their companies.

Chapter 2. Marketing Plan

2.1. Executive Summary

2.1.1. Identity of the project owner

The project name: BRINAUPRO

The owner: Ahmed Kchok

The owner qualification: licence in mechanical engineering, specialized in mechatronics.

Business setting location: Zona Industrial das Cantarias, Bragança, Portugal.

The business idea: The idea is to create an innovative device from available technologies. One of the most discussed topics nowadays is the environment preservation, including energy and water waste. Going from this point we come up with the idea of building a device suitable only for mixer water taps in order to reduce the water waste in the households by controlling the water faucet by turning it on/off in the adequate timing through detection's sensors connected to the main device's body that guides the lever of the faucet up and down. The device has a few interesting assets and add values of the market compared to the competitors which will guarantee its success when entering the market and with some improvements can easily become a vogue among other products.

Presented service: The anti-overflow device for minimizing water consumption as reducing the gas and electricity related to warming it. More than that the product includes additional features to control liquid to control the level of water when filling a container offering the user the exact quantity of water needed and reduce unnecessary water waste.

2.1.2. The mission of the company

BRINOPRO is made in order to make innovative products that aim to give solutions to customers through available technology without harming the environment. The product is dedicated mainly to domestic usage. The idea is created from the need of people to have assistance with weekly and daily repeating tasks.

Our business stands for the care to the customer need, so honesty is our fundamental core value. The commitment and the customer experience are also important to us, for that we will provide customized products for better efficiency, the company presents an innovative product so investing in innovation for sustainable development is one of our most important strategies. The product is eco-friendly, we don't want to create value on the bill of the environment. We choose to use our knowledge in mechanics and electronics in order to make our innovative ideas in the service of

people around the world. We want to contribute to make a better live with automation assistance in once life. People will have more ease to do tasks with safety and confidence.

Our service is to respond to the necessity of preserving the environment with the same time taking care of people that use a lot of water during their home tasks for cooking, washing dishes... and need automation to assist them in their household by providing them small devices with simple installation and easy to manipulate offering more diversified features with competitive price.

2.1.3. Competitive advantage

We are offering a totally new product to the market and the customer. We are offering the flexibility of use in the domestic as well as in industrial area. We are combining solutions between our direct competitors and our indirect competitors.

So, we have the location advantage, in which we don't have competitors, the location is very advantageous for doing business and set companies it offers many privileges with a rising economy. We will also use online tools to better engage customers, allowing them to reserve and pay online.

2.1.4. Financial projection

Our sale's incomes projection in the first year is estimated from 15600€, with a profit marge of 20€.19% and a net margin of 7.53€. Our break event point is estimated around 117,04€. The cash overflow is estimated 4 658,51€ for the first year. In the second year we expect a growth at 50% in our incomes. We estimate that incomes will increase to the double 31200€ by year 3. By the third year we expect a raise of 50% of the cash flow reaching approximately 7000€.

We estimate the product useful life at least 3 years.

2.2. Diagnosis of the Situation

2.2.1. The internal diagnosis

2.2.1.1. Customer's analysis

For our company the consumers can be divided in 2 categories: the individual customer (B2C) and the institutions (B2B):

For the individual customers. This category, we foresee a big opportunity to attract him by according to our research people are getting more and more aware about the environmental issues and tend more to buy product that have an impact on the environment especially east Asian and European people although their abusive use of water.

For the institutions: this category is the easiest to reach assuming that institutions have material providers and responsible how are mostly very active online and have more developed networks and information sources than an ordinary client. More than this institution such us hotels, banks,

factories... Have a lot of water faucet in bathrooms, which means they have more than a reason to reduce their water consumption, their demand is aligned with their huge buying power. It will be very attractive for them to buy a product at a cheap price.

2.2.1.2. The supplier's analysis

As most of the manufacturing companies have their own selling websites presenting different product varieties

BRINAUPRO LDA is in its first steps, so it won't have the dimension to have its own selling website, this can be placed on the further steps in relation to the development of other product sets after the hands of launching business so the main media suppliers will be the digital media channels. And for next moves we plan to hire a website manager to increase our online notoriety and gain more autonomy.

BRINAUPRO will require a big amount of space to produce its activity, meaning that it will have, as extra suppliers, construction companies for a bigger company, suppliers of extra machines for new products manufacturing, for shipping department that can be held in collaboration with other partners.

For the equipment manufacturers, BRINAUPRO.LDA will have suppliers from China and Canada as the main provider of electronic components and equipment. Those suppliers don't provide my competitors with components due to our different proceeding and components, hence they will be open to negotiations about prices. Beside that some of them are already suggesting customisation of products according to their client demands in order to increase their sales, knowing that we will be their potential wholesale buyer, this will give us exceptional flexibility in our product development. For the rest of the machinery, BRINAUPRO will use the products of the partnership of the laboratory of CEDRI and the material provided by IPB. As well as BRAGANTIA ECOPARK mentioned below in partner's analysis.

In a further step we will use welding machines from Germany from Stamos welding group for their excellent quality price products.

2.2.1.3. The partner's analysis

AMAZON, Jumia and AliExpress are our main partners for shipping offering a good marketplace platform that can consider as a place to sell their own products. Those leading companies will provide us support with their experience in the advertisement, their worldwide reputation and excellent shipping and packaging service in order to reduce unnecessary costs and be more effective in the business.

BRAGANTIA ECOPARK is a will be our partner to incubate our neighbouring business and manufacturing company in the first year. Brigantia-EcoPark Science and Technology Park is part of the Trás-OS-Montes and Alto Douro Science and Technology Park. It is managed by a private non-

profit company, with scientific and technologic objectives. Our partner will create the necessary environment for the development of our new ideas and business in order boost to the growth of companies through specific and personalized support. In the same purpose our company intend to take advantage of the resources and the university environment and opportunities to develop collaboration with other companies and institutions, through R + D + i projects. Other possible partnerships will be explored in the implementation stage of this project.

2.2.1.4. Our competitors

Our direct competitors offer an electric device difficult to install through an electrical connection as a solution for the industries to control the filling containers process by turning off and on the tap of liquid. This industrial product has few imperfections such as the higher prices and the installation complexity.

Our indirect competitors as for them, they offer a completely different approach which consist of alert the user before the overflow instead of controlling the water faucet. But there still have weakness in their products, namely: the sound of the alarm that can be low or disturbingly acute also the efficiency and customer complain about that.

Here are two relevant competitors working in different ways.

Table 1: Competitor's profile

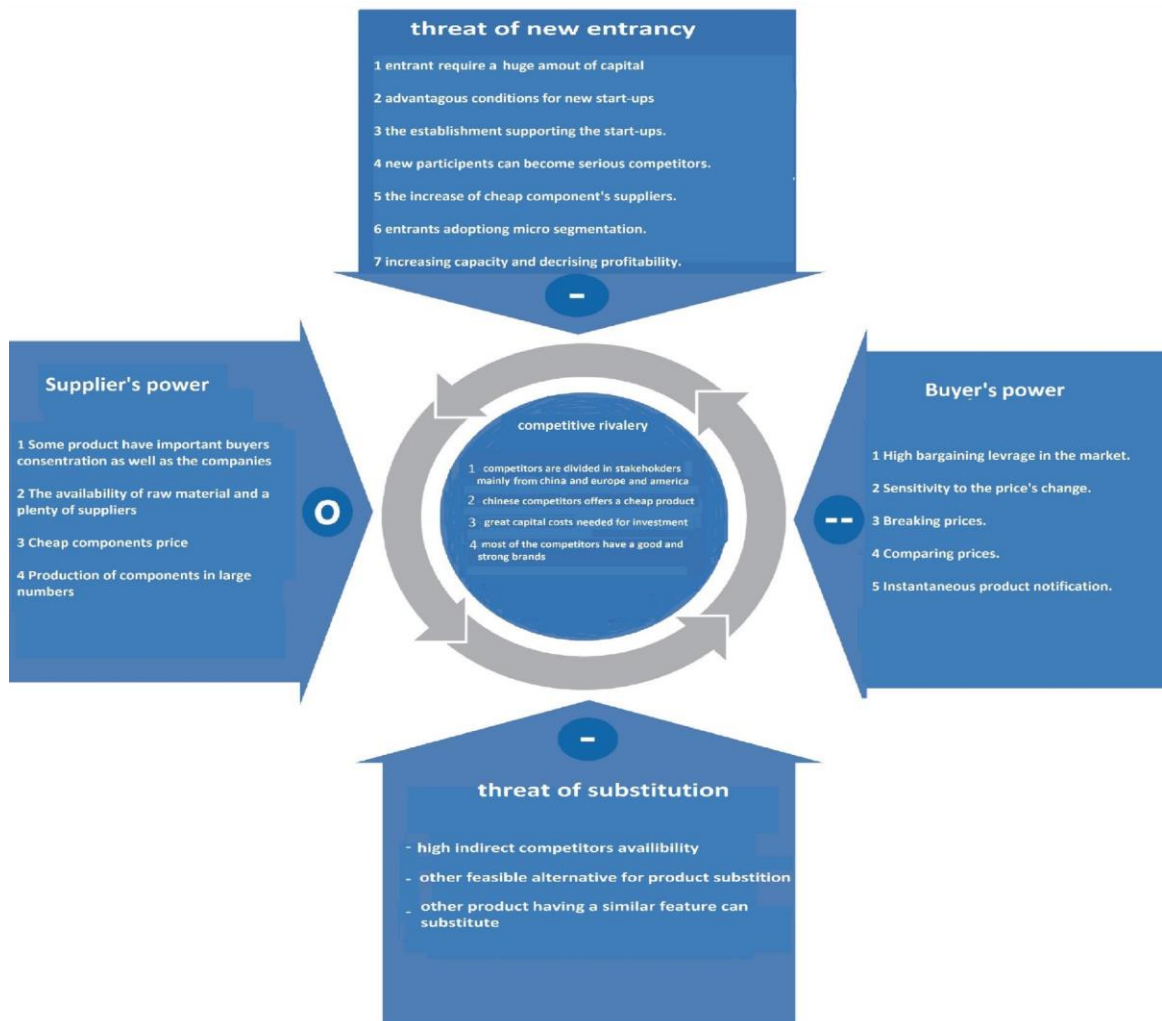
	Xiomi	Moen
Date of creation	Established since april 2010	Was registered in 1952
Missions	- constantly exceed expectations through innovations in software, hardware and services. - pursues perfection to break tradition and push boundaries.	- To conserve Earth's most precious resource - enable people to minimize their water usage, without ever having to think about it.
Size	10,001 or more employee	3400 employee
Development and revenue	Capital after IPO 3 055 000 000,00 \$US	- Revenue : 1.300.000.000 B \$US
Website	www.mi.com	www.moen.com

Address	Rainbow City Office Building 68 Qinghe Middle St Haidian Beijing, 100085 China	25300 Al Moen Drive North Olmsted, Ohio 44070 440-962-2000
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Table 2: Product comparison

	Water Detector HSWM10000	C61F-GP 220V Switch Level Controller
The operational area	domestic	industrial and Domestic
Product price	high	low
Installation	complicate	easy
Electricity consumption	high	low

2.2.1.5. Porter's five forces



Threat of new entry analysis

1. Since entering the market of home appliance, the entrant part has to make patent if they and a huge amount of capital is required, including legal cost, marketing expense, shipping and licensing want to compete. In some European countries with Portugal on the top offering tax relief for start-ups which will attract more of new candidates.
2. The increasing establishment's supporting the start-ups with funding are pushing through innovation, which give opportunity to other competitors to appear. Some new entrance can invest heavily and become quickly a serious competitor such as "XIOAMI".
3. Increasing cheap components suppliers, namely in China will open new horizon for future manufacturing companies.
4. New company tends to develop a strong position by targeting different segments or more specified ones in order to prompt customers to be on their side as the home appliance is more developed as the business in the field becomes more attractive this increases capacity but decreases profitability.

Buyer's power analysis

1. Due to multiple sellers in the given market the buyer is able to get similar products/services from other suppliers hence the bargaining leverage is high in the favour of the buyer
2. Buyers are very sensitive to the price changes when it comes to equipment, they are even capable of letting down extra features of one product for the best price of the other
3. When a seller wants to increase the good's price, buyers start reshuffling operations and negotiating pricing to cut costs and increasing their profit unlike the seller
4. Comparing prices online will give opportunity to the customer to have more choices and then better position to negotiate about the price and the quantity.
5. Using the online shopping, most of the sales websites send Buyer's access to offers from other companies instantly by getting notifications sent from other sellers which fortify the buyer's position.

Supplier's power

1. The market is dominated by 3 big brands, those deal with big numbers with suppliers the fact that make more powerful as well as their suppliers and superior than small companies.
2. Due to the developed manufacturing technologies and sales websites, suppliers are now more flexible offering different sets of raw material, It became too easy to find and customise raw material which is mostly components.
3. As every sellers suppliers are in competition rude competition presenting different kind and quality of products to manufacturers and industries the prices are different form country to another and china is one of the leaders in the low cost suppling service.
4. Suppliers are willing to sell in high amount of goods the more you buy the lowest for unit price you pay this besides discounts strategy, which can making the suppliers in a good position.

Threat of substitution

5. To substitute the level detection feature of our product customers can use a device that makes alarm when detecting water,
6. Customers can also use other simple manners like making reminder by phone. Once the container is filled or rely on its memory or attention to keep an eye on the bucket or even to pay attention to the water usage.

7. In other cases customers are simply willing to buy more simple devices and prefer to buy one of the various products that save water taps or just a device suitable for its tap with affordable prices.

Competitive rivalry

- Our competitors are from China, Hungary, Portugal, Italy, Sweden, USA the main competitors are Moen from USA, Xioami the Chinese and Hanza the Swedish.
- A lot of suppliers that are on Amazon, Banggood and Aliexpress some of them are virtual and work for a very low costs this can intensify the rivalry between small and big companies.
- In the home appliance market and in manufacturing field companies are investing a huge amount to stay in the competitiveness for improving continuously their product and investing in advertising and demand creating. Customers are trustier with big brands, for some of them loyalty for their brand can take it over the low price this is favourable to intensify competition between big brands

2.2.2. The external diagnosis

2.2.2.1. PESTEL analysis

<u>Politics</u>	<u>Economy</u>
<ul style="list-style-type: none"> - Eco park includes empowered start-ups which incubates with program in Europe and being certified by the Government of Canada and partners with public bodies in Portugal and France. - Form 2013 the business sector became a more decisive sector, gaining a significant weight in terms of performance and funding of R&D activities according to the FCT. - 96% of the tax credits approved in the period (corresponding to 118 investment projects) were directed to manufacturing. Which means that the BRINAUPRO project have good opportunity to benefit from this political fact. - On the flip side, a good relationship is a blessing for BRINAUPRO. India and China have become more open to international brands. - May lose profits in one location over another, depending on who is in charge and what they stand for. <p>For instance, an unfriendly government can make importing and exporting foreign goods a hassle. BRINAUPRO depends on these relationships to remain stable, otherwise, their revenue will be at stake.</p>	<ul style="list-style-type: none"> - R&D investment in the country is mainly concentrated on four socioeconomic objectives: (i) Industrial production and technology; (ii) General advancement of knowledge; (iii) Transport, Telecommunications and other Infrastructures; and (iv) Health. - Reinforcing the economic development and competitiveness to guarantee the creation of wealth and employment for all, in a special way for the youngest. - Manufacturing industry has benefitted from a high degree of national scientific specialisation in various areas, such as Chemical Engineering, Manufacturing Engineering and Industrial Engineering. - In the home AGEFE is especially dedicated to dealing with all business problems related to the Portuguese market, always guiding its performance by the uncompromising defence of a healthy and fair competition and to keep new-born companies such as we.

<u>Social</u>	<u>Technology</u>
<ul style="list-style-type: none"> - Four constructs that directly affect the usage intention: performance expectancy, effort expectancy, social influence, and facilitating conditions. - Social influence through the increasing impact of the social network. People are becoming more used to online activities such as selling, buying and other tasks related to do business. - Using experiencers and helpful friends as social influencers is a possibility to reveal some defects emergent to fix or further improvement can be suggested from them. - The exact place of the product. and the way it's presented plays a big role in customer's attraction. Other than this, the information about the product must be well described since customers doesn't buy product while having uncertainties. - Obtaining evaluations and suggestions of customers by e-commerce is a good point from which is possible to update our product according the changing requirement of customers. 	<ul style="list-style-type: none"> - With the internet literally at our fingers (thanks to our smartphones), people are likely to check out offerings online. Nowadays, every business should have a functioning website. - Improving the water proof quality of product because some of the used components are not completely water proof due to the quality and the restrained purpose of use therefore. it requires more treatment and must be well conditioned such us the water level sensor. - Current product in the house frame consists of an alarming system. This feature is not always appreciated and it's can be complementary and not as main features. - Using software (Arduino, c, python) and hardware (sensor + actuator) to develop a better solution. - The user intention to use a product is predicted by two major variables: The Perceived Usefulness and - The Perceived Ease of Use (including the design, the size and the weight). The product may not adapt all kind of faucets

<u>Environment</u>	<u>Legal</u>
<ul style="list-style-type: none"> - No big electricity consumption. - Solving a form of water waste that represent. - Preserve clean and dry environment. - Reducing water consumption while the demand of water is increasing by a growing population. - In 2016 a survey targeting dwellings in villa real, north Portugal showed a high consumption of water up to 494,71 L/day by dwellings gathering. - 49,9 by average per consumer daily concluder by a study in 2019. - Using batteries as power supply. 	<ul style="list-style-type: none"> - Several import and export requirements and documentation apply to those companies, locally registered, that want to engage in international trade from Portugal. - The registration for EORI is made with the help of several documents like the Certificate of Incorporation of the company, the VAT certificate and the power of our attorney. - The registration of an LDA in Portugal is not subject to complicated formalities, but one should respect the following: <ul style="list-style-type: none"> 1/ A name verification and reservation are needed in the first place for our trading company in Portugal. 2/ The Articles of Association are the company's main documents with information about us as the company owners, the activities, general rules and many more. 3/ The minimum share capital must be deposited in a local bank account. 4/ The registration for tax purposes is another mandatory condition

The economy of bragança:

The adjacent location of the Cantarias Business Hosting Area to the Cantarias Industrial zone, as well as its proximity to the A4 and IP4 nodes, with excellent road connections in Portugal and Spain, makes this space a reference for the dynamization of collaborative logics and it allows to take advantage of the predictable agglomeration economies and network effects, with clear gains for the competitiveness of companies and the region.

Bragança presents a competitive territory in the economic area, that involve from year 2000, the territory of Bragança ensures security for every qualified company, thereby it is a very good place to settle one's firm.

From 2017 The Municipality of Bragança does not apply for tax on the taxable profits of companies based in Bragança in order to strengthen the city's economy, which is a good opportunity for development in the future growth of the company.

2.2.3. Strategic potential analysis

2.2.3.1. Our vision

To become a Portuguese home appliance's accessories manufacturer meanwhile to sprout a good brand for the future relations with our clients, suppliers and partners we believe that the development of a business is relying on our ability to keep in touch with our customers.

2.2.3.2. Our mission

Furnish innovative solution to eventual customers in the domestic area and to try to assert our technical abilities and knowledge in the service of our customers within taking advantage of newly available technologies and combine between them to make a better sense of our product offering new perspective for development.

2.2.3.3. Ambiance

The product is almost noiseless, with just a very short acute noise of the actuator when the mechanism works to shut off or to turn on the faucet.

The product is completely waterproof. The electronic box and the sensors are made of plastic as for the actuator and the guiding rod, they are made of aluminium. The whole device is completely resistant to the sun rays and have a good resistivity to heat because of the aluminium material.

2.2.3.4. Special layout

The product ideal for the mixer lever taps which are a very famous and most used kind of faucets, the suited layout is when the backspace of the faucet is large. The more the space is larger the less bulky the device will be the better the device will melt into the background.

2.2.3.5. The values

We believe in the values that are fundamental and we want to care about our customers attentions. Which include the environment, considering that the nowadays customers tend to buy a product that has good impact on the environment. Time is also an important thing to ponder as well in a century of quick rhythm of life.

2.2.3.6. The swot analysis

<u>Strength</u>	<u>Weakness</u>
<ul style="list-style-type: none"> • Combining technologies • Autonomous product • Save water and energy • Gaining time • Avoiding extra work (drying the overflowed water) • Eco-friendly product • Low battery consumption • Additional feature 	<ul style="list-style-type: none"> • The system cannot be settled in every kind of water tap • The system is not wireless • Noisy shut on/off process • Some customers can find it very expensive • No good quality components
<u>Opportunity</u>	<u>Threat</u>
<ul style="list-style-type: none"> • The first Product • The increasing awareness and interest in eco-friendly products • Diversity of components in the market • Taxes reliefs and facilities • Shipping and packaging services availability 	<ul style="list-style-type: none"> • Cheaper products competitor can enter the market • Better quality product can be developed • The system has limited function (limited slice of customers)

STRENGTHS:

We pointed out 7 assets to our product based on innovation and sustainability, which are very important criteria and can be a guarantor of interest for the further development of the device.

- With one accord, technology is becoming more diversified. For instance, sensors and actuators are available in different variety, size and power. It was considered with consultation of our mechanical and electrical experts/professors, that taking advantage of available technologies in the market is a better way to ensure the success of our product, knowing that beforehand of making a new product or invention into reality we must consider the maturity of the technology.
- Comparing our indirect competitors, our product doesn't need the intervention of the user in the process. In our indirect competitor's case (standing for alarm system) the reaction of the user when hearing the alarm is the decisive event otherwise the problem will occur.
- This point is maybe one of the two most important strength points and main objective of the solution proposed. The anti-overflow acts to save water by avoiding water overflow from baths, sinks or buckets. Also, it restrains the debit of water in daily usage by optimising the faucet use turning on and off the water tap in the good timing. In addition, the energy of gas and electricity produced to warm water will decrease as well making the product economically efficient.
- Filling buckets with liquids that can be milk, water or oil. is among tasks in industries and annoying tasks for workers, so it's better to let automation take care of this task which will give the user time to do other things and take the bucket when he feels ready. It's the same case for cleaning maids, they just must settle the sensor and leave the bucket.
- Avoiding the overflow is the benefit of the previous point, avoiding overflow will indeed make us gain time, but also make as avoiding extra exhausting work.
- Our product works without harming the environment, in contrary the technology base on low electricity consumption and the absence of any kind of waste make of my product the perfect eco-friendly device.
- The component used to make my product is defined as low electricity consumer, the device's size is considered among small sized devices smaller than 15*15cm which means low electricity need also the chosen liquid level sensor produces an electric signal forms magnetic field, in other word the sensor does not need power supply at all.
- The most innovative part in our product is the additional feature that detects the water level from the containers. Well, one of our most relevant strengths is the ability of the device to turn off the tap when detecting the water top/required level in the recipient before overflowing occurs, while our competitors or relying on alarming users before the problem occurs.

WEAKNESS :

These 4 paragraphs describe the product's main weaknesses, however, some of those characteristics are temporary and represent just the weakness of the minimum viable product, for sure we expect to improve as possible our product in order to reduce them.

- The water taps are nowadays very diversified, so it is nearly impossible to concept a mechanism able to handle with all the water taps, however, we intend in the future to improve our products by creating different other mechanisms suitable for every water tap system.
- Wireless technology in product is getting more and more improved and in usage so it might be another characteristic to improve on my product. Such a detail can be crucial, especially for industrials head's buying decision. Certainly, beginning with a high technology is not the best idea to do business in my case, taking into consideration the technology costs.
- It was important to mention that this fact precises that the noise is made only from the shut off mechanism. A research conducted me to discover that customers are paying attention to lesser noise in the product. Moreover, they are disturbed by all-top sounds. Fortunately, the mechanism is quite fast and the water tap shut off is about parts of a second so the noise is not persistent.
- It is no secret that mechanical, electronic components are very costly in Europe, so turning attention to the Asian products from countries such as China and India is more interesting but still have the additional costs which are basically the shipping and the taxes reaching more than the component unit cost, therefore it is natural to have an expansive product for beginning.
- In order to make a cheaper product we must avoid buying expansive components the low prices of the component can reveal a weak quality product, although it's expected to do the required work the most of the component in question are from China.

OPPORTUNITIES:

We foresee a good opportunity, presented here-by those opportunities are promising a good path for our product's development and business prosperity.

- According to research and market observation, our product is the first to be included in the domestic service and using a different approach for the industrial area. For this we have a good opportunity to set price first for a better control of the market.
- Unlike for the full automation companies, others companies are still need suitable equipment to their process, but the tendency is overwhelming and all industries are looking for equipment to include automation in their operational machines and tasks for better organisation.
- Through the big popularity raised by the communities nowadays online stores are very developed some of our eventual suppliers are just virtual companies and how numerous they are! T Through the big popularity raised by the communities nowadays online stores are very

developed some of our eventual suppliers are just virtual companies and how numerous they are! The components are also in different varieties and the choice is abundant of switching supplier to another to be more innovant thus more competitive.

- The components are also in different varieties and the choice is abundant of switching supplier to another to be more innovant thus more competitive.
- Most of the countries In Europe have establish associations to support start-ups and incubate them even for small business companies that we will be there is calls for capital funding to support them specially to survive the COVID situation, innovation in technology is now highly demanded since Europe commit to compete against china in the industrial manufacturing.
- Shipping and packaging is becoming a speciality task and more shipping companies are including packaging such as Amazon and AliExpress these companies present a very good solution for micro and small manufacturers as it is a real opportunity to avoid spending money on necessary shipping and packaging departments.

THREATS :

We highlighted 4 potential threats as any company/product can have. Some of them are expected to be overcome, but it is necessary to keep them on our viewfinder.

- As our company still at the start, other companies have better means to make better products for low prices. But it is possible to overcome this problem by investing of further improvement supported by funding and set the bar high for them.
- Current products entirely based on the alarm and alerts are not really considered as competitors as they do not affect the same function and doesn't respond to the need at the same way that my product will. Despite that fact, the companies are becoming more competitive than before and the possibility of the product adaptation it no longer a hard task for them. As it is the case in technology, this threat cannot be ignored.
- Having a limited function means very specific purpose which means a slightest slice of customers, but this doesn't deny the possibility to make a better product able do by used by different other slices of customers.
- This water leakage / level sensor is not really famous for many people. Products using these sensors are nearly absent in domestic use. Although the tendency to buy new product using water sensors is increasing, according to our data analysis between 2019 to 2020. We can consider the creation and the growing new need for the automation in the field.

2.2.3.7. Manufacturer

This research was made in order to better understand the available technology in the market in addition, the research will help us to increase our awareness about possible manufacturer and figure

out our future wholesalers and suppliers. The more diverse they are the better innovative solutions we will have, knowing that flexibility in our products will be targeted as one of our main strategies to raise up our company therefore, we analyse manufacturer of every component we need.

The level sensor is a device used to detect the level of liquid in a tank, it can act on a pump, an indicator, an alarm or other devices.

The principle of float type level is that a float moves up and down due to the increasing level of water. A switch in the float is actuated by a magnet and outputs detection signal.

The level sensor suppliers in America:

- Madison Company : a USA manufacturer of standard and custom

Products: Liquid level float switches and sensors including ultrasonic sensors

Address: s: 27 Business Park Drive, Branford, CT, 06405

Email: info@madisonco.com

- Minco : this manufacturer designed a level sensor for a point detection in any Conductive fluid by passing a low voltage AC signal between two stainless Steel probe.

Product: Conductivity Level Sensor

Address: 7300 Commerce Lane North Minneapolis, MN 55432

Email: info@minco.com

- HARWIL: this company presents many level sensors models such L40 and L21 L-8 which is adjustable for different specific gravity fluid.

Products: Level switch model L-40, L-21, L-30, L-8, L-5, L-5 stainless steel

Address: 541 Kinetic Drive, Oxnard, CA 93030

Email: orders@harwil.com

- TTI Inc.: this company has many addresses in America and presents different



Variety of floating liquid level sensors with detailed datasheets

Products: [59630-1-T-02-A](#)

[LS01-1A66-PA-500W](#)

Address: 2441 Northeast Pkwy, Fort Worth, TX 76106, États-Unis

Email: information@ttiinc.com



The level sensor suppliers in china:

➤ **Wuxi Oumisi Mechanical & Electrical Co., Ltd. :**

Products: PP Liquid Water Level Sensor Horizontal Float Switch White \$2.00 - \$10.00 / per piece

Address: 11-1101, Jinke Center, Fortune Commercial Plaza, Taihu Avenue, Wuxi, Jiangsu, China

➤ **5C electronic co, ltd:**

Product: Stainless steel Dual Float Water Level Sensor S1AA Customizable \$10/ per piece

PPplastic horizontal mounted water tank usage liquid float level sensor

PP plastic vertical mounted liquid water float switch level sensor liquid usage

Address: Room 601, Unit 6, Yaju Court, Sanwei, Xixiang Street, Shenzhen, Guangdong, China

➤ **Shenzhen E-5continents Co., Ltd.:**

Product: stainless steel [5CFS-S1A41](#), [5CFS-S1A29](#), 5CFS-S1A3,

Plastic: 5CFS-P1085, 5CFS-P1043, 5CFS-P0835, 5CFS-P0825

Address: 4th Floor Building B2, Sunshine Industrial Zone, Hezhou, Xixiang, Bao an District, Shenzhen, China

Email : sales6@e-5continents.com

The sensor level shop in Portugal

PT ROBOTICS: (Praça do Relógio 15 store 3 2635-457 Rio-de-Mouro, Portugal)

The linear actuator motors supplier:

Manufacturers from CANADA:

➤ ACTUONIX:

Actuonix Motion Devices was originally founded in 2004 under the name Firgelli

Technologies Inc. At that time, they were a sister company to Firgelli Automations who sold larger linear actuators while we sold the smaller ones. The two companies have always been independent entities, they just shared the Firgelli name. In June of 2016 they decided to eliminate the confusion between the two businesses, so they renamed themselves Actuonix Motion Devices.

Products: Mini Linear Actuator Motor

Speed Range: 30 mm / s, 15 mm / s, 9.5 mm / s, 5 mm / s

Maximum Load: 4 kg (80N.)

Voltage input: 12v

The length: 9cm minimum and 14cm maximum

Address: 1753 Sean Heights Unit 201, Saanichton, BC V8M 0B3, Canada

Email: sales@actuonix.com

Indirect competitors:

Concerning our indirect competitors, they are numerous, but here are the main companies. Their products don't have the same features then ours but respond to the same need. They dedicate their products for both industrial and domestic areas. According to this research our direct competitors are mainly concentrated in the industrial.

In china:

➤ **BAOJI TITANUM INDUSTRY CO., Ltd:**

The first brand of China's titanium industry. Baoji Titanium Industry Co., Ltd. was established on July 21th 1999. As one of the world's leading titanium producers, we are the largest titanium manufacture and research base in China and the leading enterprise within the titanium industry in China.

Product: Wireless Water Tank Overflow Alarm

Address: No.88 High-tech Road, Baoji, Shaanxi, China 721014

Email: iedept@baoti.com

➤ **Toviviov by Shenzhen Tianzhi Wulian Co., Ltd:**

Established in Shenzhen, China in 2015, Wulian Electronic Co., Ltd. is specialized in wireless smart home system, DIY home alarm system, calling system, etc... The factory has grown rapidly and expanded globally to accelerate product and business development efforts. Wulian is one of the leading factories in the Chinese home automation and DIY home alarm industry.

Boasting a global research and design team with top-notch industry experiences and diverse backgrounds, Wulian is privileged to work with more than 40 hardware/software engineers and wireless communication specialists, as well as more than 10 graphic and industrial designers who all endeavour to deliver on Wulian's never-wavering promise of staying true to people-centric, caring innovations.

Product: WiFi Water Leak Detector, Water Sensor Alarm WiFi Water Leak Sensor, Smart Flood Detector

Address: 2nd Floor, No. 8, Nanlian 6th Industrial Zone, Zhenpuling, Nanlian, Longgang Subdistrict, Longgang District, Shenzhen, China

Email: sales@wulianelectronic.com

In Canada:

➤ **moen:**

This canadian company is mainly a water faucets manufacturer, specialised in modern faucets technologies. The companies are concerned about water usage which conducted it to product a water detection system.

Product: Smart Water Detector Leak Detection System Smart Water Shutoff

Address: 2816 Bristol Cir, Oakville, ON L6H 5S7, Canada

in USA:

➤ **shonmau :**

This brand belongs to the American virtual company X-Mall US

Product: High/Low Water Level Sensor Detector Alarm

WiFi Water Sensor

Water Leak Detector with wifi

In UK:

➤ **AGS Home solutions Ltd:**

AGS Home solutions Ltd is specialized in goods of house safety

Product: Water Detector WLAN

Water detector, WiFi

Address: AGS Home solutions Ltd, Grosvenor House, 11 St Paul's Square, Birmingham, B3 1RB

Email: agssolutions7@gmail.com

➤ **Mumbi:**

Fonded in Jan 1, 1998 and adopted by Germany from 2008, Mumbi became an e-store that trades cell phone accessories, computer accomplices, cables, adapters, security systems, and household accessories.

Product: WM100 Water Alarm

Address: Essen, Nordrhein-Westfalen, Germany

Email: service@mumbi.de

Indirect competitors:

Our direct competitors present product able to switch off the water flow and even turn it on for some of them such us level switches but they are limited to the industrial usage and electricity source due the complicated electrical installation of their products.

In china:

➤ **Xiaomi Zajia:**

Xiaomi Corporation was founded in April 2010 and listed on the Main Board of the Hong Kong Stock Exchange on July 9, 2018.

Xiaomi is currently the world's third-largest smartphone brand and has established the world's leading consumer. In August 2020, the company made the Fortune Global 500 list for the second time, ranking 422nd, up 46 places compared to the previous year. Xiaomi also ranked 7th among internet companies on the list. The company created a brand-named Xiaomi Zajia which develops other products than phones which makes of it a fierce competitor.

Product: Automatic Detection Infrared Induction Water Saving Device

Address: Rainbow City Office Building 68 Qinghe Middle St Haidian Beijing, 100085 China

Email: service.global@xiaomi.com

➤ **BAKEEY:**

This Chinese company is owned by Shenzhen Yisi Technology Co., Ltd and it offers a large product sets Apparatus for transmission of communication; Cabinets for loudspeakers Close-up lenses; Covers for smartphones; Diffusers for use in photography; Electric cables and wires; Flashlights for use in photography; Headphones; Horns for loudspeakers; Microphones; Monopods for handheld digital electronic devices, namely, cell phones, MP3 players, personal digital assistants; Remote control telemetering machines and apparatus; Smartwatches; Sound recording apparatus; Stands for photographic apparatus; Telescopes; Tripods for cameras; Wearable activity trackers

Product: Infrared Intelligent Automatic Sensor Induction Faucet

Address: 2/F, Yili Technology Park GuanLan Rd, LongHua new Dist ShenZhen CN

518000 China

Email: sale@archeer.com

In USA:

➤ **MOEN:**

One of the world's largest manufacturers of faucets, sinks, and other plumbing products, Moen Incorporated ranks as the leading manufacturer of single-handle faucets, the top seller to the wholesale market, and the leading brand of faucet in the North American faucet market.

By 1970, when Standard Screw was renamed Stanadyne, Inc., the Moen Division had grown to become the company's most important operation. Stanadyne's sales had increased from \$49.1 million to more than \$120 million over the course of the previous decade.

During the 1970s and early 1980s, Moen grew from a niche player among faucet manufacturers to the number-two marketer During the late 1980s and early 1990s, Moen's product line diversified in both form and in function. Moen's faucets ranged from traditional cross-handled designs to sleek contemporary looks.

Between 1990 and 1994, Moen's sales nearly doubled

Product: Automatic Sense Faucet Infrared Induction Water Saving Device Address:25300 Al Moen Drive North Olmsted, Ohio 44070U.S.A.

Email: (protected)

Websites: www.moen.com

In Sweden:

➤ **HANZA:**

Sweden based company involved in strategy and manufacturing of high-tech products. Its business idea is to collect different manufacturing technologies in factory clusters. The business areas of the company include Business Advisory Services, Simplifying Eco Design and Manufacturing Solutions.

Product: touchless vanity

Address: Brovägen 5182 76 Stocksund Sweden +46 08-624 00 00

Email: info@hanza.com

Website: www.hanza.com

In Hungary:

➤ **KESOTO:**

Located in Budapest, Hungary and is part of the Photographic & Optical

Equipment/Supplies Manufacturing Industry. KESOTO Kereskedelmi és Szolgáltató Korlátolt Felelősségű Társaság has 4 employees at this location and generates \$ 112,565

in sales (USD). It attended annual revenue \$112,565 in 2019

Address: Kondorosi út 2/a A. ép. fszt.Budapest , 1117Hungary Email:
(protected)

In Italy:

- **WANG XUEQIN** : WANG XUEQIN started since 2005 and now has 3 employees at this location and generates \$206,866 in sales (USD). There are 2 companies in the WANG XUEQIN corporate family.

Annual revenue were estimated at \$31,826 in 2019

Address: PORDENONE, PORDENONE, 33170 Italy

MILANO, MILANO, 20133 Italy

In Portugal:

➤ **KCASA:**

This company is entirely virtual specialised in waterproof and Splashproof Products and Flameless USB Rechargeable Li-on battery to ensure high security

It is also working in the field of house appliance electronic innovative small and big sized products

Its operation field is large namely: gardening, kitchen, dining and bar and home decor.

Product: Revolving Water Faucet with interface for cold and hot water

Address: R. Monte Pedro 3, Baguim do Monte, Porto, Portugal

Email: (protected)

➤ **Perfet:**

This brand it a derivable of Fujitsu

Product: Touchless intelligent sensor faucet

Address: Av. Dom João II 404 2ºAndar, 4715-275 Braga, portugal

Email: (protected)

2.2.4. Strategic Marketing Objectives

2.2.4.1. Financial

In the first year we expect at least the half of the sales of our competitor (828/year) ensuring at least 20000,00 € with the financial support of investors and sponsors since our product is completely new and different. After one year of distributing our product through international selling websites, our customers will be more aware of it and the consideration of our product will increase at least 15%, according to our expectation therefore we expect not less than 15% of the revenue increase.

We expect at least a slow increase in our customer's number as well as sales frequency during the next 4 years. The financial source of our business will be sponsorship agreements. For that we must charge low prices more and more when gaining more viewers and customers then our agreement will captivate more sponsors and attract fellowships which will increase the revenue it is possible to begin with a start-ups incubators during the first year and then spreading our network of financial the value of these agreements represents values that are around the thousand euros.

We think that 5% increase is a fair value to increase annually. To keep supervising our sales, we can set a website and get information and metrics of sales from Google analytics and earn comments from customers and establish connection networks with our suppliers and distributors.

2.2.4.2. Marketing research and limitation

A good quantity of our data concerning our customers are related to a survey elaborated and addressed to 40 of our customers the research was made in order to understand the customers preferences about characteristics of the device and the degree of the demand of the product as well as comparing it with our competitors in order to give more freedom to our customers we didn't precise names and personal information.

Since we are working on an innovative product it was no identical product to target its development, so we were collecting data from our competitors in some features and combine with other indirect ones when it comes to the other feature of our product.

2.2.4.3. Conclusion

The internal and external analysis of the organizational environment is very important for the determination of the policies and vary to the strategies in order to respond effectively to the negatives. From these analyses it is clear that the priority to give is for the manufacturing in Bragança and start with a small range of client weaving a good brand in Portugal.

The market it is better to enter the market using the home market production by direct export BRINAUPRO must invest in marketing due to the intense competitiveness. Then BRINAUPRO must base its strategy on foreign exchange earnings, domestic market with growth and expansion objectives. One of the advantages of this strategy is to provide us the possibility to withdraw from the market relatively cheaply and easily, when needed.

However the main disadvantage of this approach is that the company can be at the "mercy" of overseas agents and so the lack of control has to be weighed against the advantages.

Keeping abreast of the internal and external environmental factors of the company will enable BRINAUPRO in making priorities and strategic plans along with the variations of these plans.

2.3. Segmentation and Targeting Personas

2.3.1. Primary end-users

Our primary end-users are the industrial workers and the cleaning maids in (institution, hotels, schools) their age is between 18-55 years old they are not expected to be educated but supposed to be formed by their instructors from institution/company about how to use the device because those persons will use directly the product and are the subject of our services. Although we don't get profit from them as we know that they are hired by institutions and societies, the profit will be rather made from the online payment of the employers that will buy the product for them as equipment.

2.3.2. Secondary end-users

Our secondary end-users are the housewife's and individual persons, mostly females between 25 to 40 years old who used to clean their houses multiple times a month and are interested to use our product when needed. We have more than 60% of people cleaning their homes more than 4 times per month which makes our product profitable to them. Besides the increasing awareness of saving water in domestic use, through the analyses of our indirect competitors' sale's numbers. we have concluded the increasing number of sales from the individual persons. This customers slice will pay by product unit. Likewise, they also can contribute in the payment through the payper-click advertisement.

2.3.3. Tertiary end-users

Our tertiary end-users are mainly both of the "industrial equipment buyers" and "executive housekeeping directors" for society specialized in housekeeping and cleaning.

This slice of customers is between 30-48 years and mostly males, they are highly educated and know how to manage a screw, they are reachable through social medias Likewise, they are active members in social media such as LinkedIn, Keejob and Facebook and so they can be interested in online advertising. Our product is addressed to the ones seeking to ensure organisation, safety and comfort. Develop new procedures to increase efficiency of labour and product use. Search and test new techniques and products in the market.

For instance, a responsible of few cleaning maids, who faced problems many times due to frequent mistakes made by the maids one of his biggest problems is when maids use water buckets they don't care about water waste, when filling buckets with water they forget to shut off the water tap which engenders overflow and time waste. Making remarks toward maids and advising were not enough for solving the problem especially with elder maids. In this case he needs a radical solution.

Our product can provide him the solution he needs. BRINOPRO provides him a sustainable product conceived for intensive uses and not just to avoid overflows but also to control the water level that means cleaning maids can settle the sensor in any level needed to have the precise water quantity they need. That will help them to reduce used water quantity.

2.3.4. Positioning

Positioning corresponds to the position that a product or brand occupies in the minds of consumers vis-à-vis its competitors on various criteria such as the price, the field of usage and the opportunities of the market.

As we intend to provide our customers with a technical solution, we the product is perceived and will be always a device that we manufacture. The domestical field has always was a subject of interest for BRINAUPRO, for instance manufacturing companies are using other products to control their use of water of their machine during the production those products are electronic devices that are applied to their machinery for such purpose those products are positioned in machinery and industrial

equipments. Similarly, BRINAUPRO will deliver devices that are suitable for house faucets and further with time the possibility of manufacturing other products, but still designed for home's applications therefore the brand is positioned in the home appliance. Although the product also oriented to the institutions and the industries.

But this doesn't make any change to the range of the product since the device will directly interact with the faucet that used in homes.

2.4. Marketing Mix

2.4.1. Product

My ideal customer is probably female that use water a lot in the kitchen and spend much water during their day such as filling buckets for mopping their home or washing dishes. At the most, the product offers good help for cleaning maids when exercising over their daily work.

BRINAUPRO offers a new product for these people how tries to have a better control of the water waste and they know that they are wasting too much. The product aims to reduce the water waste through 2 ways:

- Controlling the level of water in a container when filling, then the user will have the exact quantity needed and avoid overflowing the water and waste it by forgetting
- Turning on and off the water tap when needed automatically to optimise the consumption

The packaging will be taken on the responsibility of amazon which also secures the shipping as well as the payment through different ways so the payment can be by credit and debit cards and transfers from your available Amazon Pay account balance. Credit cards currently accepted include Visa, Mastercard, Discover, American Express, Diners Club, and JCB. Amazon is a big society that has a lot of shipping lines in the whole world so we work on a worldwide scale to reach our customers.

2.4.2. Promotion

The water that everyone uses in the house is the same that is used in hostel, in schools, in hospitals... Their common point is that they all are interested to make a difference by saving energy since it results cheap costs bills. If the product will be affordable in price the customers will be more interested and we are able to make it for them.

BRINAUPRO will begin the promoting of the product with on the top "have more control" as a slogan this incisive BRINAUPRO will begin the promoting of the product with on the top "have more control" as a slogan this incisive word will have a good impact on our customers to arouse their curiosity. itive word will have a good impact on our customers to arouse their curiosity.

We will communicate them the emergency of preserving the environment by saving energy and using eco-friendly products.

To measure the success of the campaign will be used the click through rate of the video, media reaction, social media reaction as “likes”, “shares” and comments.

Positive comments, number of store’s visitors, sales and marketing research to identify dynamics.

BRINAUPRO will organize the presentation of its product and its collection of products (later) the company will also thrive its marketing strategy by collaborations to the press to create media pressure before the beginning of the sales.

We believe in sustainability and we want our customers to be satisfied of dealing with us so we offer promotions for users that buy our product:

- For 2 devices containing at least the proximity detection features the customer will be awarded by 20% discount on the 2nd one.
- For more than 3 devices the customer will have a 30% discount on the last device.

Amazon also contributes to help our customers to decide about our product:

- Coupons from 10% up to 40% of the product price. As we work with Amazon our customers will also benefit of the Amazon loyalty program.
- For 1000 points accumulated entitles you to a € 50.00 voucher for the entire site.
- For 1500 points accumulated entitles you to a voucher of € 75.00 on the entire site.
- For 2000 points accumulated entitles you to a voucher of € 100.00 on the entire site.

2.4.3. Price

The price of the product will be 40€ which is affordable and rational compared to similar products. And considering the component’s and the production unit’s costs. The customer can have the whole device with the water level detection option and proximity detection for the price 35€. The production of the first product unit is 36€ but we expect in principle of 16% off on the price of components when buying in large quantity. Which will drop the cost of production down to 30€ and the price will be initially set at 35€, we do intend that further negotiations will continuously take place to decrease the costs much more reaching 25€ and the price down to 30€ in the 3rd year.

2.4.4. Place

BRINAUPRO has already determined its distribution channel that will be the online stores, including the most known stores in the European, the African and the Asian continent respectively Amazon, Jumia and T mall Global and then as a second step we will spread our product in home appliance shops.

According to some researches, the B2B is not very trusting as a sales support so it must be supported by client services. These are mainly about the maintenance of the devices that must be installed or repaired. In addition, the client can always read our product specifications and manuals. If there are questions, they can reach out our sales support team.

It's also intended that one of our best strategies for supporting sales is to promote our products and increase awareness about our machines, assuming that customers who already have a boat the X equipment can become a technical support for other buyers and makes the technicians save time and energy instead of in the favour of the company

2.4.5. People

BRINAUPRO will adopt an individual marketing that consists of making a website. This site displays relevant information detailed and sketches. So, when our customer is going through these sites feels as if the information is for his/her own convenience.

For a shopper who buys from various internet sites, as it is a time saver as well as personalized shopping.

In case of comments or queries the customers must be responded within 24 hours in order to keep his interest on the product. Otherwise, the customer can completely loose interest or will engage other procedures like weaving negative reputation for the company.

Our company is open to recruit good young talents for it and their benefits with time our company will commit in the challenge of improving the quality of the products for and developing new others, for that we need to look always for recruiting by creating jobs opportunities for high-skilled workers the candidate can apply from our website or come to our local to submit his curriculum vitae and the required documents as appendix.

As our partner will be Bragania Ecopark, this association is already working on organising events and conferences which will represent a huge opportunity to make more partnership. This will be for offering a better experience of training and skills improving programs of the participant from our works since we will keep them aware of programs and events in their field.

BRINAUPRO is standing for trust and aims to company its employees during their career so following this principle in the enumeration of its employees. Besides annual subsidies and according to the participation in the suggested development programs and the competence and perseverance of the employee, the enumeration will be more significant. So, the employee will gain more when making the company gain more.

2.4.6. Process

To better understand the customer orientation. As a company, we must always put it in his place to be in a better position to help him, then the customer will sense the extra effort made by the company to understand his situation and to really understand him better and to be able to help them.

BRINAUPRO is able to put itself in the place of the customers and share his challenge the engagement of our employees will be the key of the success with our customers. The customer's goals will be the mutual goals of the company.

BRINAUPRO will establish its business basing on the good behaviour and mindset in order to stay tuned when helping the customer and acting for his best.

Before every new development of an existing product or a new one the customers must be informed and must be able to consult the new blogs containing drafts and images to describe very well the suggestion for the website. This will give the company's screw the possibility to reconsider their plans or to adapt them according to the internauts interactions. Another approach that BRINAUPRO will adapt as all innovative companies do is to launch a trial version like MVPs for designing persons that will judge the product before the great public.

As mentioned previously the research and development will insure by the cooperation between our dedicated human resources and developers or inverters that want to help further researches and develops the R&D activities are already suggested by Bragantia Ecopark.

2.4.7. Physical evidence

Physical Evidence is the final element of the three additions to the basic marketing mix as proposed by Booms and Bitner (1981). The Authors define it by 'The environment in which the service is delivered and where the firm and customer interact, and any tangible components that facilitate performance or communication of the service'. Retail premises, bank branches, restaurants, or hotel premises would be good examples of this.

Physical environment

Of course, our product will be a device that will be that will be installed to guide the water faucets the most usage environment are places such as bathrooms, toilets and kitchens as main contexts of the product dedication. A web site will be at the disposal of the user to comment, send doubts or complain about the products. The website will be www.BRINAUPRO.com.

Besides the product, the user can have the user's manual in the package or download it from the website directly in case of lost. The instructions will be clear and stranded by describing images if needed.

The product is almost noiseless, with just a very short acute noise of the actuator when the mechanism works to shut off or to turn on the faucet.

The product is completely waterproof. The electronic box and the sensors are made of plastic as for the actuator and the guiding rod, they are made of aluminium. The whole device is completely resistant to the sun rays and have a good resistivity to heat because of the aluminium material.

2.4.7.1. Spacial layout

The product ideal for the mixer lever taps which are a very famous and most used kind of faucets, the suited layout is when the backspace of the faucet is large. The more the space is larger the less bulky the device will be the better the device will melt into the background.

2.4.7.2. Corporate branding

Now the customers would be able to control their water consumption without even care of it. The best way to of environment preserving is when our customers contribute to save energy by placing a machine that will keep intuitively in consumption under-control.

2.4.8. Payment

For the first year the payment will be made through the online payment through web sites such Amazon, Lazada and Aliexpress.

For the third year we will put our product in the home appliance shops located in Bragança, in Tunisia and India this will give the possibility to pay cash instead of paying online which allow to all the slice of our customers to reach our product in those countries, the next step will be to broaden our selling shops buy dealing with more shops and supermarkets from other countries in north Africa namely Algeria and Morocco. The payment through credit cards will be in every case accepted including Pay Pal, master card, Alibuy and visa credit card that are most used in the three customers locations for more flexibility American Express will be considerate among payment methods hence we avoid putting barrages between our company and customers from different other countries from mentioned.

As evidence of payment tools efficiency:

According to statista Mcommerce, it is expected to account for 72.9% of all e-commerce by 2021. This is a massive rise from 58.9% in just 2017. While China is, by far, the most responsible for this growth, figures from India and other developing economies are not worth scoffing at, either.

Amazon is the leading online retailer reporting net income of \$3.6 billion in 2019. According to a survey conducted in March, 2017, 42% of online shoppers rate credit card payments as their preferred mode of payment. This is followed by electronic payment, with PayPal as the most relied upon service Debit cards follow closely.

2.4.9. Placement

According to our research customers are mainly located in North Africa and centre Asia. According to our data in North Africa, single lever mixer taps are becoming a trend and used a lot in the houses. Industries in north Africa using this kind of taps in liquid containers can take advantage of our product. The infrared and automatic water taps are not really spread in North Africa, although being famous in Asia and Europe. The second main position of our customer is the west and centre of Asia because they use a lot of containers in their homes to collect water to drink or for mopping according to their ways of life and these people are the most concerned customers in that way, we have manufacturing competitors offering of automatic taps. On the other hand, other kind of product such us the water

level alarm is dedicated to the purpose of water level control. However, people may have an interest in a product that unifies both products at an affordable price.

The third kind of customers are the ones who are more interested in the proximity detection is south Europe, namely: Portugal and Spain knowing that in Europe there is an important number of customers start using similar product to optimise water waste and usage.

2.5. Operational Plan

2.5.1. Specific objectives and short-time action

According to our research customers are mainly located in north Africa and centre Asia. According to our data in North Africa single lever mixer taps are becoming a trend and used a lot in the houses. Industries in North Africa using this kind of taps in liquid containers can take advantage of our product. The infrared and automatic water taps are not really spread in North Africa, although being famous in Asia and Europe. The second main position of our customer is the west and centre of Asia because they use a lot of containers in their homes to collect water to drink or for mopping according to their ways of life and these people are the most concerned customers. In that way, we have manufacturing competitors offering automatic taps, on the other hand other kind of product such as the water level alarm is dedicated to the purpose of water level control. However, people may have interest to a product that unify both products in an affordable price.

The third kind of customers are the ones who are more interested in the proximity detection is south Europe, namely: Portugal and Spain knowing that in Europe there is an important number of customers start using similar product to optimise water waste and usage.

Our long-term objectives, meaning over the 4th year is to add our own departments of marketing as well as shipping and packaging one with the online assistance we will offer an excellent service of shipping in short time and less problems.

We will also implement our products in shops and in the year 5 we will begin to raise our own shops in the main countries where the most of our customers are located. After we will be in great position to negotiate better with our suppliers and set a better price with preserving our profit. We will also make profit from creating other products for home appliances standing for the afforded technologies and combining the solutions with our partner to have more impact on the market and in order to become a bigger company with larger commitments to our customers.

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2.5.2. The schedule

In the table below we have put all the scheduled principles and strategy of behaviour that will be our future guide in managing our business. Precising our key activities, our key partners, channels and our revenue stream using the canvas.

Table 3: Canvas

<p>Key activities:</p> <p>What key activities do our value proposition requires? Manufacturing, sales.</p> <p>Customer's relationships. Co-creation between the company and the customers and take advantage of their expectings. Utilising user communities to become more involved with customers/prospects.</p> <p>Our distribution's channels. Through sale websites: Amazon, Banggood, Aliexpress...</p> <p>Revenue streams. Benefits by selling the product.</p>	<p>Key partners:</p> <p>Who are our key partners? network community, social medias and manufacturers.</p> <p>Which Key resources are we acquiring from our partners? components costs and shipping facilities, shipping.</p> <p>Which key activity do partners perform? advertising, packaging and shipping.</p> <p>Who are our key suppliers? Mechanical and electronic component's manufacturing.</p>
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<p>Key resources:</p> <p>What key resources do our value proposition requires?</p> <p>Intellectual resources, physical resources, human resources and financial resources.</p> <p>Our distribution's channels.</p> <p>Indirect channel.</p> <p>Producer, wholesaler, retailer and customer.</p> <p>Customer's relationships.</p> <p>1)Customer acquisition.</p> <p>2)Customer retention.</p> <p>3)Increasing the sales.</p> <p>Revenue streams.</p> <p>Shipping and Shopping.</p>	<p>Customer relationships:</p> <p>How do we get, keep and grow customers?</p> <p>Improvement of the product</p> <p>Which customer relationships have we established?</p> <p>Social medias (customer's comments) and online advertising</p> <p>How are they integrated with the rest of our business model?</p> <p>By the co-creation.</p> <p>How costly are they?</p> <p>According to component's cost, the estimation of the product will be 37€.</p>
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<p>Channels:</p> <p>Through which channels do our customer segments want to be reached?</p> <p>Social medials and selling websites.</p> <p>How do other companies reach them now?</p> <p>By ordering items from selling websites.</p> <p>Which ones work the best?</p> <p>The wholesales generate huge revenues.</p> <p>How are we integrating them with customer's routine?</p> <p>Shimmering the importance of the product by applying 'story telling' approach advertising.</p>	<p>Revenue streams:</p> <p>For what value are our customers really willing to pay?</p> <p>Automation assistance in specific tasks.</p> <p>For what do they currently pay?</p> <p>the production and shipping plus the added value.</p> <p>What is the revenue model?</p> <p>Pay per user from sales websites, credit cards and commissions.</p> <p>What are the pricing tactics?</p> <p>Increasing longside the demend.</p>
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2.5.3. The budget

Considering the one-year marketing plan implementation and regarding the BRINAUPRO brand's size and scale, the marketing budget consists in 25 690 €. As shown below, this will include all the eventual expanses to run our business properly. This amount will be split between several communication channels in order to ensure that the brand's marketing objectives are met.

Table 4: Budget table

MARKETING PLAN	SPECIFICATIONS	INVESTEMENTS
The local rent	Per year	2 400 €
The annual energy consumption	Per year Including the water, gaz and electricity	700 €
The insurance	Per year Safety insurrance	600 €
The production costs	Per year	14 490 €
The equipment's	Undefined duration Including computers, software licence, machines, working tools	2 300 €
The advertisement	Undefined duration including facebook and google adds	1 600 €
The selling web-sites	Amazon, Tmall Global, Aliexpress, ebay, jumia	1 800 €
The work force	Per year Including 3 workers	28 800 €
Total	Total amount needed for one year investment	25 690 €

Chapter 3. Literature Review

3.1. Supervising system with advanced features

The author in [9] discussed a possible implementation of a camera to visualise, analyse and detects the washer's hand. The solution consists of the programming the microcontroller through Python. An approach, referring to the segmentation integrating colour and motion. In addition to the hand detection his solution encloses another feature such as the bottle detection that concerns the water level detection. The bottle is detected, and the bounding box is computed. By that way the machine will calculate the amount of the required water for the hand otherwise for filling the bottle/container. As a result, the accuracy obtained for the detection of hand is 85.7% and for the bottle is 77.8%.

In another paper [10] researchers have had discuss a solution comprising of an infrared spreader and receiver circuit, as well as a unit and a solenoid valve. The infrared sensor is used to detect hands. This investigation came as a response to requirements of irrigate level manager in irrigation farming. The working principal is the following: The pouring rate is determined through a Hall effect Sensor. The Hall Effect irrigates flood sensor is a used sense unit with a turbine rotor. The device is able to changes its rotational speed in response to the irrigate flow rate. As a result of the project was a low-cost solution as well as being simple for Mounting and the accuracy above ground.

The investigation paper in [11] is about a system that consist of a solenoid valve that will block/liberate the water flows, thus the project aims to concrete a smart water meter monitor connected to an application through WIFI in order to send real time data. This feature is insured by the electronic chip ESP8266 equipped with WiFi. The card is relates to an Arduino mega as an entry extension in addition, the ATmega328P micro-controller put out instruction that is synchronised by the hardware, which then executes the desired operation.

Users can use two extra functions: Set Timer and Set Plan. Users can use the Set Timer function to set a timer to turn on/off a water supply tap.

3.2. Water level systems review

C.Rojha suggested in her paper a solution standing on a several basic sensors such as voltage sensor, current sensor, oil pressure sensor, temperature sensor and gas sensor used for oil well data sensing. [12]

The aim of the paper is in fact the detection of eventual abnormality. In case the abnormality is found, the maintenance manager is notified of the problem. The manager's mobile phone receives an SMS notification of the issue through GSM. Oil wells can therefore be observed and managed from a distance as a pump can be switched off, the function of the system is insured through a microcontroller as we will see below.

Based on the previous paper E.V Ebere and O.O. Francisca described the water scarcity as the major problem' facing the biggest cities' of the worst in identifying the solution deploying computer's technics in order to stand against this wastage basing themselves on 'assembly language [13].

The solution offers more financial benefits and energy savings, but also promoting environmental protection and the water cycle, which ensures that we conserve water for future use.

The system can detect the amount of water in a tank and turn on or off the pump in response. It uses a microprocessor to automate the water pumping operation in an overhead tank storage system and reveals the condition on an LCD display. The water level sensor is made with a metal plate mounted on the container or the water tank.

This study has been successful by using it, current water level controllers were enhanced. Instead of a calibrated circuit to show the water level and use DC of AC power, removing the danger of electrocution. Sensors, comparator circuit, microcontroller, display unit and the pump are the elements of work detecting the level of water which are done by the LM324 comparator. Taking advantage of the electrical conductivity of the water copper conductors at the water level transfers voltage from one to the other this will generate a HIGH/LOW signal and feedback the microcontroller Atmel 89C52. A Liquid Crystal Display (LCD) serves as an output unit which showed the status of the system on a screen. Some relays were used in building a switching system for the pump.

Speaking about device controlling water level K.Wijaya discussed a possible implementation of a circuit working with 4 probes as well the paper was updated by the web site "Circuits Today"[14]. The document used as the previous an Atmel chip AT89S51 for controlling the water level where the sensor is available on the website: store.circuitstoday.com .

The circuit energises the pump through the detection of the system uses 6 transistors, 1 NE555 timer IC, a relay and a few passive components. The system consists of the switching off/on the pump when the water level in the overhead tank goes above the full level. The probes are positioned at different levels of the tank. Once the lowest probes is not detecting water, transistors become energized and LED diodes are switched off and a relay will activate the pump to full fill the tank.

Otherwise, once water detected at the highest level, the transistors will be deactivated in contrary of the probes that are alimented so the relay will stop leading current to the pump.

It was suggested that the probes can better be made of insulated Aluminium and placed vertically inside the tank. The tank depth must be taken into consideration while determining the probe wire's length.

The latter must be maintained every one to two months since they will electrolyte because DC is utilized in the level sensing portion.

Once the water is above the minimum level The circuit is completed by an LCD display with a short message.

B.Oduro mentioned in his document entitled 'Automatic Water Level Monitor and Control' a system of water level control specific for domestics and house's purpose only [15].

The author talks over a bespoke design parameter for an automatic control water supply system and shows interest to demonstrate either Arduino microprocessor can be implemented for such design or not. So, to eliminate the risk of spilling out water from the tank by carelessness, but also hazardous conditions for personnel, and/or fire and explosion. The study's output was a flexible, affordable, and easily changeable system built around the inexpensive PIC16F84A microcontroller. The paper takes into consideration an overview about centrifugal pumps as the main actuator of water flowing A web and mobile-based monitoring service protocol was presented to determine and feel water levels globally. The system was based on Arduino Microcontroller.

Solar energy from a photovoltaic source powers the system. The Arduino controller module represented the area of the circuit that would make the logical judgments necessary to direct the water flow from the sump to the reservoir. It also displayed the pump's status and the water level. In the event that the microcontroller fails, the interface block module performs an additional task of hardwiring a system to indicate the water level.

The conductive technique was used by the hardwired level indicator. This meant that the sensors are turned on when they come into contact with the reservoir's and sump tank's water. The CD4066 which is used as Level Indicator switches, IC and its accompanying LED outputs for the quarter, half, three-quarters, and full levels made comprised the hardwired level indication.

As a result, the system was constructed in the electronic Laboratory at the Kumasi Technical University.

As tested the system works very well and perfectly detects 4 bearings of the tank and some specific states were verified such us the error state condition for one quarter full of reservoir was such that the System delays of 10 mins then switches pump ON. The Error condition occurs when the pump is OFF and Water level is low. This would display ERROR on the LCD and cause the buzzer to sound.

C.N. Anyanwu, C.C. Mbajjorgu, E.C. Anoliefo [16] evaluated a possible solution to control water flow in tank by introducing the MC14066 integrated circuit as an automated regulator appropriate for water level sensing and control was created. This allowed the circuit in general to operate as a threshold detector, acting as an ON/OFF switch.

The result was as system able to maintain the set maximum and minimum levels of 50 litres and 10 litres respectively, by switching the pump on or off as required.

As the previous system the envisaged system, which is a closed loop-control device makes use of liquid level as input to control power supply to a liquid pump. Thus, the output is a discrete variable (on/off) actuated using an electronic circuit.

Two electronic sensors will be positioned at the proper locations to detect the low and high values in order to monitor the liquid level. The system's real advantage comes from the fact that it is not constrained by the size and composition of the liquid tank. Thus, by simply installing a regulator sensor inside it and connecting the circuitry, an existing liquid tank (of any material) can be transformed into a control tank.

Without a signal from the control, the electrical path of the 12Vdc cannot be completed. The control pin is grounded through a 100k resistor to ensure that the signal is only delivered to it when there is water. A second wire is linked to the pin and hangs at the desired height for water contact. The tank was then supplied with another 12Vdc. As a result, the connection to the control pin is open circuited when there is no water in the tank, which causes the 100K resistor to draw the voltage down. A signal is produced at the control pin as the liquid level rises and establishes an electrical contact the circuit diagram in the figure 5.

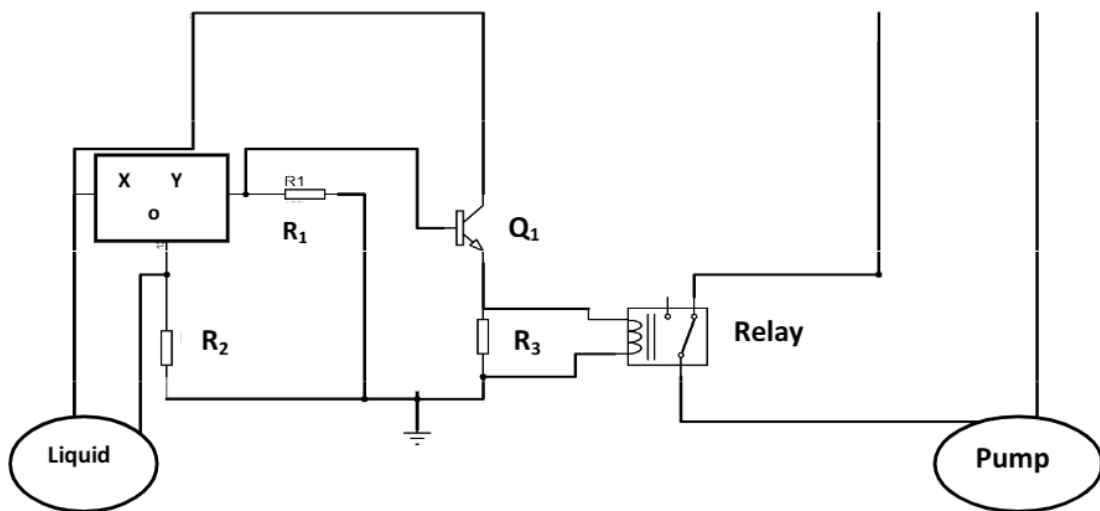


Figure 5: Diagram of the circuit of water level controller

Source (extracted from DESIGN AND IMPLEMENTATION OF A WATER LEVEL 2012)

The evaluation of the realized system showed the following and coveted behaviour water was continuously drained from the tank until the low level was reached, at which point the regulator turned on the pump. As long as the system had electricity, the regulator was able to successfully maintain the water level between these limitations.

3.3. Automated water tabs review

According to a paper written by A.Al Yemni, S.Al Bamam, S. Al kulib and Q.Abu Al Haija [17] a research has shown that up to eight liters of water can be wasted every time someone turns on a hot tap and waits for the water to reach the required temperature. With more than 60% of million households now using a combo-boiler, which means hundreds of millions of liters of water unnecessarily goes down the plug hole every day. The research aimed to save time and money from water bill, it also aims to detect the user's temperature, evaluate it, and then carry out a specific function based on these data that will automatically adjust the proper water temperature for the user. Additionally, finding the ideal ratio of heat to cold might be challenging. Nearly 40 m of 20mm pipe can be found in a typical residence. It has a 12-liter water.

The working principal of the system's function was the following: When the user touches the sensor, it will first begin to measure the body's temperature, and we will then receive the result as a numerical value. The data will then be sent to an Arduino Uno for analysis and conversion into temperature scales, whether in Celsius or Fahrenheit, before being sent as a signal to one of the two relays based on the user's temperature. Next, when the appropriate relay receives the signal, it connects the valves to an external 27-volt battery to open the valve. Finally, the valve will release water at the proper temperature for a predetermined period.

The Journal of Physics published a document made by that suggested a system using Arduino mega 2560 in order to control a water tap This device does not require the use of a water pump because in the case of de work the author considered that the reservoir is positioned higher than the water tap [18].

Ultrasonic sensor and PIR sensor both were employed, but not simultaneously with the aim of determining the difference in response time between opening and closing the water tap. If a human or other object is in front of it at a particular distance (less than 10 cm). The ultrasonic sensor acts as a sender of information regarding the presence of objects (human) in front of the water tap in this automatic faucet system. The water tap will open.

The patent of Gregory et al. on April 5th of 1988 suggest a modular water faucet with an automatic water supply system connected to the spout [19].

A decorative panel with a range of patterns and/or colours. The base's modules can be stacked to any desired height, and the base and spouts can be switched out. Infrared light is used by the control system to identify objects. There are ways to distinguish between ambient light and reflected light. The system prevents water from flowing if any extreme temperature is detected.

The faucet has a manually activated on-off switch which is used to turn on the faucet for continuous water flow in a manual mode of operation. In the manual mode the faucet can be turned on even if

the water supply temperature is in excess of the predetermined temperature. In the event of power failure, the faucet is manually operated by a drain cap knob.

The system of Peterson et al. to control water faucet was published as a patent. The system is shown above [20].

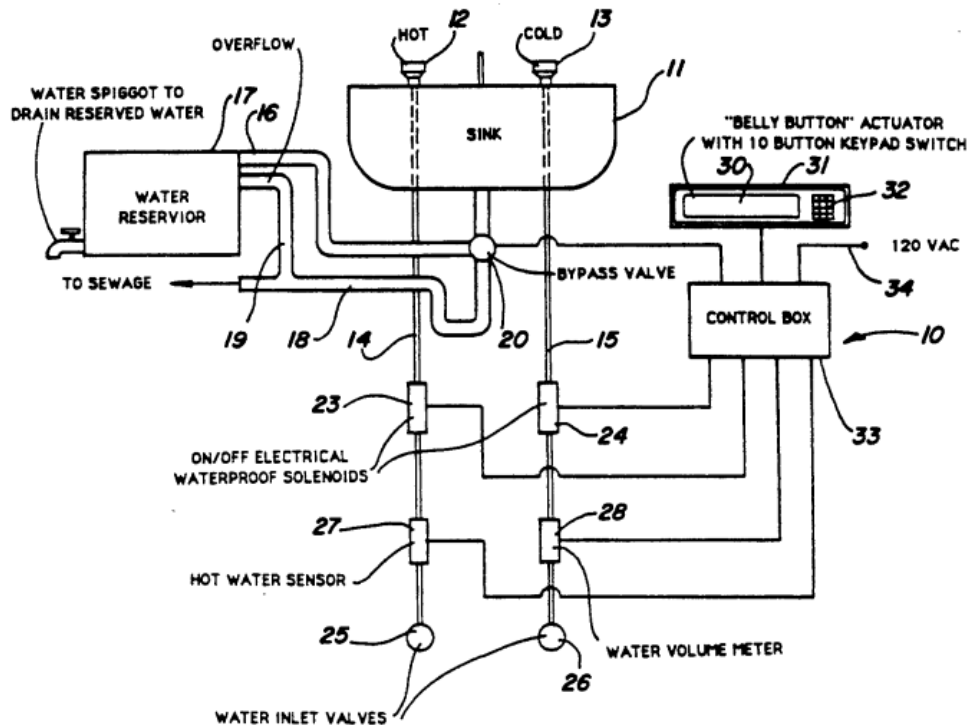


Figure 6: Peterson et al. faucet control system

Source: (Option et al., 2019)

The invention is a new and improved system controlling water delivery to a kitchen sink. It is specific to the function of on/off of the water tap. The patent mentions multiple others that were its preceding, namely from U.S. patents number 3,370,609; 3,374,957; 3,450,159; 3,556,146; 3,576,277; 3,638,680; 4,189,792; and the previous literature [19] 4,735,357. However, according to Peterson his work presents the exclusive ability of saving cold water.

The system is very complex and includes connections between pipes, reservoir, control box and panels reaching the sink through valves and solenoids. The system, on the other hand, the system evacuates the undesired water. The system is based on an undefined microprocessor, including a programming and command keyboard input and an electrically actuated control box connected thereto for controlling operation of the by-pass valve, water flow rates, water temperature, and the on-off solenoid valves which control hot and cold-water flow, the control box being electrically connected to the microprocessor, by-pass valve, on-off solenoid valves, temperature sensor and water volume meter.

The interrupter of the system is a switch to step on that is mounted on or closely adjacent to the sink, and when pressed, will turn on the water flow if the faucets that are in the "on" position once a person is in close proximity to the sink and apply pressure of their body against the switch.

Chapter 4. Material and Method

4.1. Related work

In this chapter, we will shortly describe the industries of automation with the concern of the automated taps and water alarm that constitute our most successful competitors, but also quiet good examples namely Xiaomi from China and the noteworthy Moen from Canada.

This example will put us in the surrounding of the competition to better understand the objectives and the innovative points that we can focus on.

4.2. The automated taps



Figure 7: Water tap of kitchen sink

Source (Universal kitchen faucet with hot and cold water de Aliexpress)

Automatic faucets, which are known for their assertive attributes, are becoming more common in some one's daily life and places where the elderly and/or handicapped live. Automatic faucets can save up to 70% of the water that would otherwise drain unused and save up to 3% of the water used by a typical household. Other advantages of automatic faucets include preventing the spread of germs, which thrive on faucet handles, as well as preventing or mitigating scalding incidents caused by hot water flowing out of the faucet. However, I should point out that automatic faucets are not anti-scalding devices on their own.

- A solenoid-operated diaphragm valve is tasked the interaction of opening and stopping the flow of water. Geared motors are used by a small number of international manufacturers to open and close valves.
- Sensor and control electronics whose combined function is to detect the presence of an object in front of the faucet and command the solenoid valve to open and allow water to flow.
- Batteries or an AC transformer is commonly used as a power source. This component must be readily available to ensure faucet operation. C, AA, 6Volt, and 9Volt Lithium batteries are frequently used.
- The spout of a faucet is used to convey water. Most automatic faucet spouts are designed to house the sensor capsule within them, or in the case of one noteworthy rival, fiber optic cables to transport infrared signals from the sensor to the spout. Sensors, control electronics, solenoid valves, and even batteries are all housed within some spouts.

4.3. Elaboration of surveys for potential users

Surveys are a special research tool with strengths, weaknesses, and a language all of their own. The purpose of the survey is to get answers to important questions. For the most part, they're used to find out what people think about a subject and why they feel that way about it. It is also about the problem we are trying to solve with the data you collect.

The purpose of our surveys is to better develop the device according to the understanding of your audience with the aim of informing decision-making. The understanding is based on consumer behaviour, attitude and product preferences. The surveys can justify the collecting of data that is vital to our research.

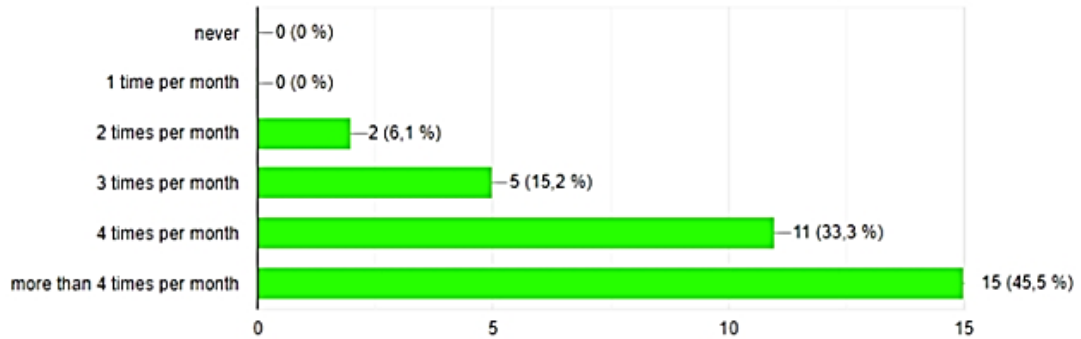
The survey includes a short video simulation and questions concerning some habitudes doing certain tasks like cleaning.

The survey was conducted after a second prototype created through AutoCAD and too much improvement was demanded by the audience.

Here are the survey's results that we will discuss later in the test and result discussion chapter

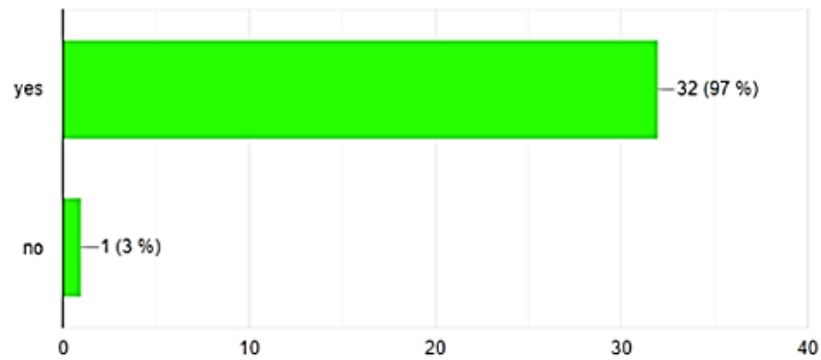
how much times a month do you clean your house?

33 réponses



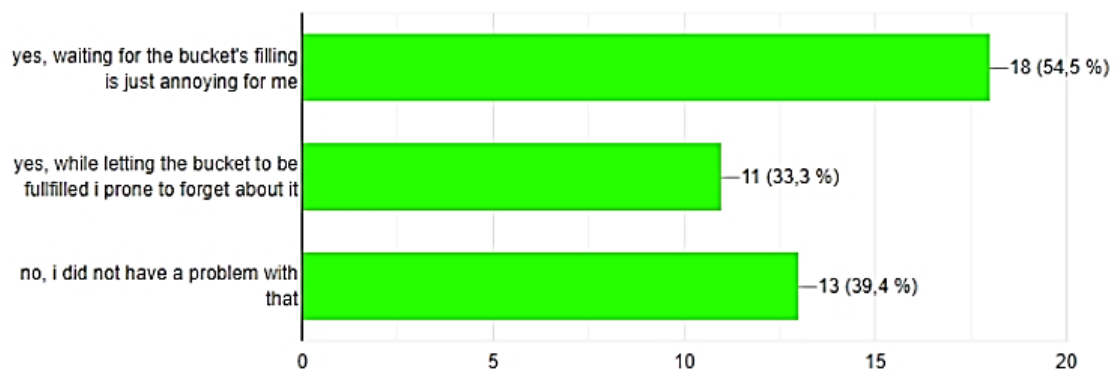
do you use bucket and brush to clean the floor?

33 réponses



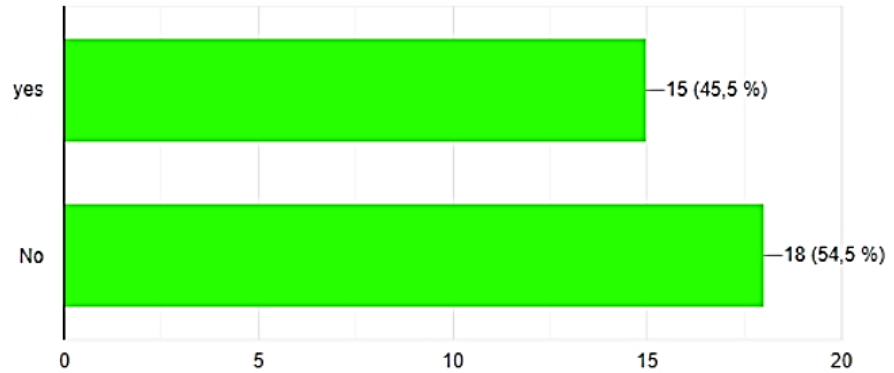
if yes, have you already faced problem when filling a bucket?

33 réponses



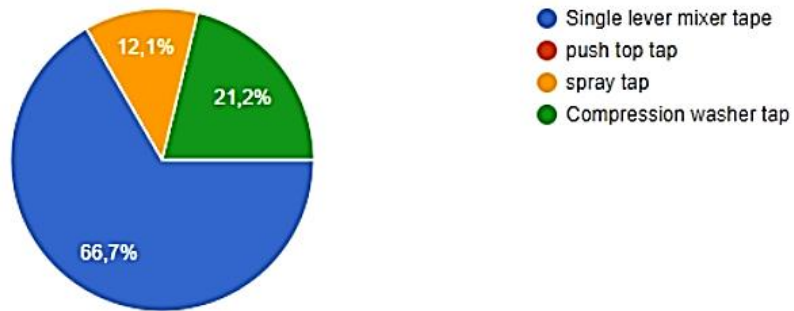
Do you sometimes forget to turn off the taps on your bath or wash basin?

33 réponses



what kind of watertap have you in the bathroom?

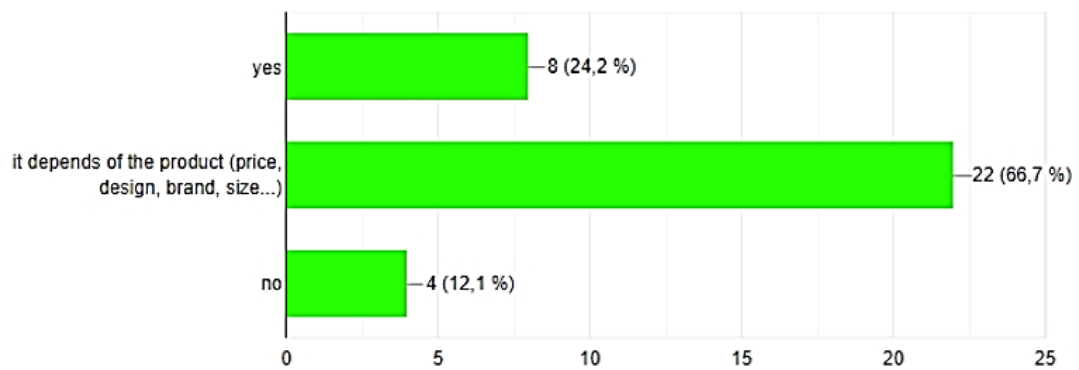
33 réponses



the system will detect the water-level at the top of the bucket through a sensor and shut off the water tap automatically before the overflow

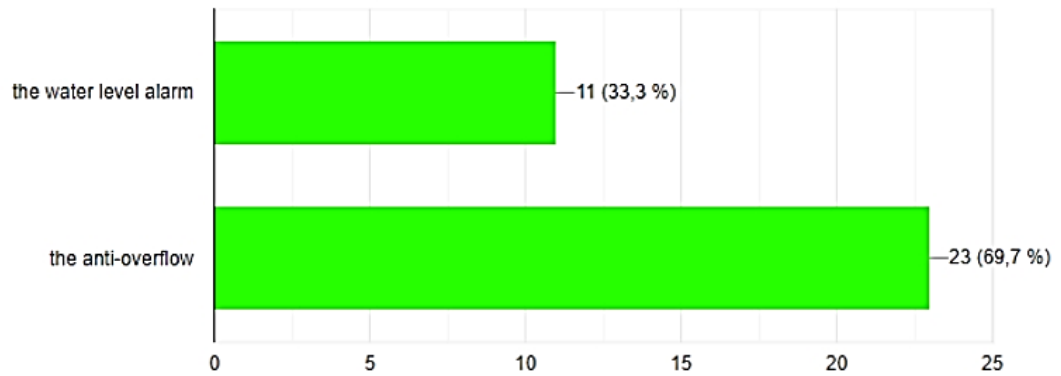
if you were a responsible of cleaning, having maids under your responsibility and working for hostel, hospital, school... will you buy this product among their cleaning equipments

33 réponses



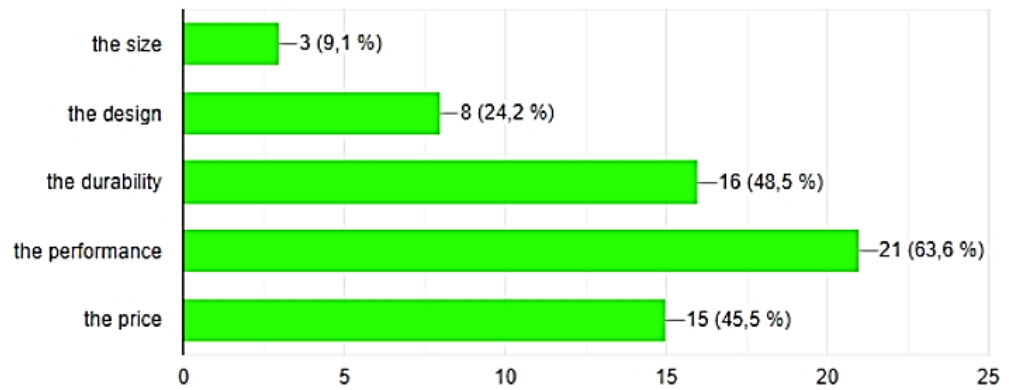
if you have to choose between our product and a water level alarm wich one is better?

33 réponses



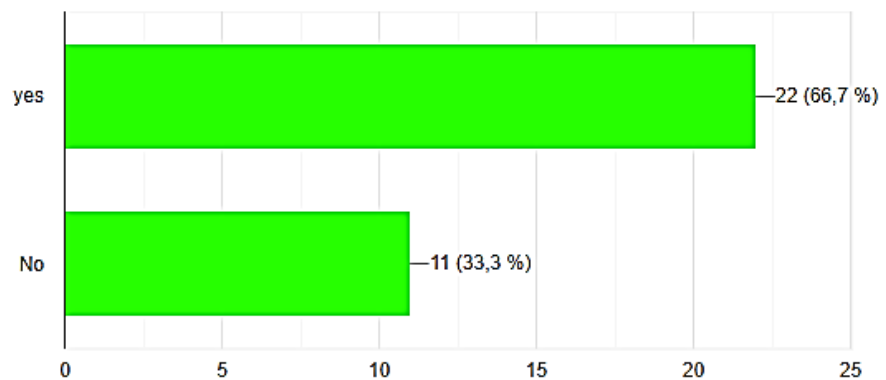
which is the most important criteria this kind of product (machine)?

33 réponses



do you think that one of your family members can be conserved by one of these 2 products

33 réponses



why is the chosen product better than the other in your opinion?

20 réponses

Better control and not control by everyone

None because I do not need

The sound of the alarm make me nervous and disturb my activity.

Because I need the system can torn of bathroom when is fill.

Seems easier to use

In this case there is no noise. The tap will stop itself

It, s a new product

Efficacity

The size

why is the chosen product better than the other in your opinion?

20 réponses

It helps me to save water

The anti-over flow would unable the problem while the alarm would just announce that the problem occurred.

COM ALARME AINDA PODEMOS DESPIRDIÇAR AGUA

I chose this type for a number of reasons, firstly, the efficacy, secondly, reassurance that the water had stopped running from the runoff, and the second product I might not realize when the bell rang

Installation simple et moins couteuse

I think the product do not replace each other...

The first

I do not know

4.4. Prototyping method

Here are the steps which allowed to define a possible approach of the prototype's creation. The first 3d conception is made in order to give more credibility to the presented idea. The 3D conception was an asset in term of idea registration and gave a predictive vision of the product in development. The first prototype was designed through FreeCAD and which an open-source software dedicated to 3D mechanical conceptions and architectural design:

One of the most important functions is the functional modelisation allows the user to modify the shape of the solid through features contained in the library of the software. As we see in the small video, we are able to make extrusion or removing material. Besides using specific features for instance: chamfer or fillet another function is the volume modelisation with which we were able to use simple primitives to create cube and spheres for the request of complex solid whereas it is possible to change the relative position of primitives by increasing and decreasing the interpenetration of the volumes, we can also customise the shape by varying the angles and dimensions (length, width, depth) of the primitives.

So here were the components used in the first 3d prototype and the imagined representation

L298 which was later replaced by L293 drove the stepper motor to drive and motor up and down in order to switch off the water tap for that module only 3,3v to 5v power supply was required. For the first prototype we thought that a normal power supply of 9v was enough to make the PCB's, the electronic cards working.

The NEMA T6 linear slide stepper motor of the figure 9 was chosen to actuate the turning off process driven by the H bridge L2 98. As shown in Figure 11 some shapes are added in order of fixation and laying down guidance. The device was looking very bulky and not attractive as a commercial product.



Figure 8: Slide stepper motor

Source (extracted from TOAUTO in Amazon)

For sensing the water level, a water sensor of Arduino was used as shown in the Figure 10 the image on the left. The sensor will detect water by sending an electrical signal to the microcontroller's input. This liquid sensor was replaced by a vertical reed float switch for a better sensitivity (image on the right Figure 10). This latter is able to detect different liquid sorts, not just water by oil, fresh drinks and so on. Moreover, the switch is thoroughly waterproof. The resulted conception is shown in the figure 11.



Figure 9: Water level sensor

Source (Author own modification)

Improvements are still yet to come with the changing of the actuator which is one of the masterpieces of the device according to a survey conducted in order to understand the customer's opinion about the first prototype in Figure 11. Subsequently, the sliding stepper motor in Figure 8 was changed to the mini linear actuator Figure 12 and 11.

The prototyping of the hardware according to the second presentation revealed that the in the Figure 12 the actuator was not enough long to reach the height of the faucet in addition of the lake of flexibility to be adjusted to different levels. So, modifications had to be done despite the prototype was recognized as attractive. The following prototype in Figure 12 includes effective modifications such as the collar added on the spout of the tap offering a better stability for the actuator and better on/off shutting off the faucet.

The mechanic conception was made through SolidWorks and three designs were proposed as steps leading to the final one like shown in the Figure 11 and finally the Figure 12.

The linear actuator gets changed to the miniature one. To find out the limitations of the actuator through the strength and intensity as decreed in the table 5.

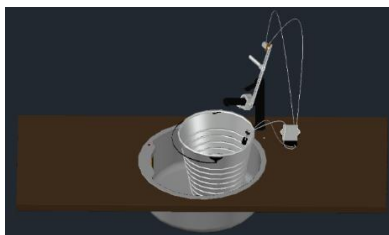


Figure 10: Second prototype by AUTOCAD



Figure 11: First prototype by AUTOCAD

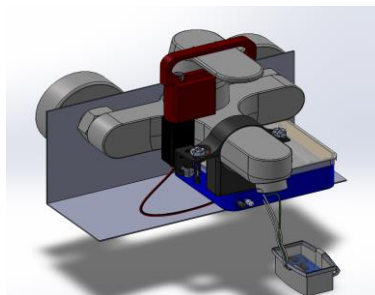


Figure 12: Final prototype by SOLIDWORKS

Source: (Author's own elaboration)

4.5. Creation of the first prototype

The prototyping is an experimental process where our design is implemented from ideas into tangible forms from paper to digital. The main motive behind this is to validate the design of the actual product. Sometimes, creating a prototype is called materialization as it is the first step of transforming the virtual or conceptualized design into the real physical form. Importance of a prototype.

In order to concrete our study and shift from the theoretical vision to a practical solution. We started by using basic materials from plastic.

The first prototype was made with non-functional components as the ultrasonic sensor supposed to detect the proximate objects was represented by as the lid of a bottle tied to a rubber of shoes. The water level sensor, although is real and functional, but needs to be stuck in the bucket. So we used a plunger.

In the first place the handle conceived for the faucet had a large and a round shape linked to a guiding rod. The ended prototype in figure 13 was just made as a representation and not in order to make it function. Experiment targeting mechanical testing revealed that in the prototype was very weak as the material use can easily break up. As we needed a better prototype in attractiveness and functionality, so we kept the mini actuator motor only.

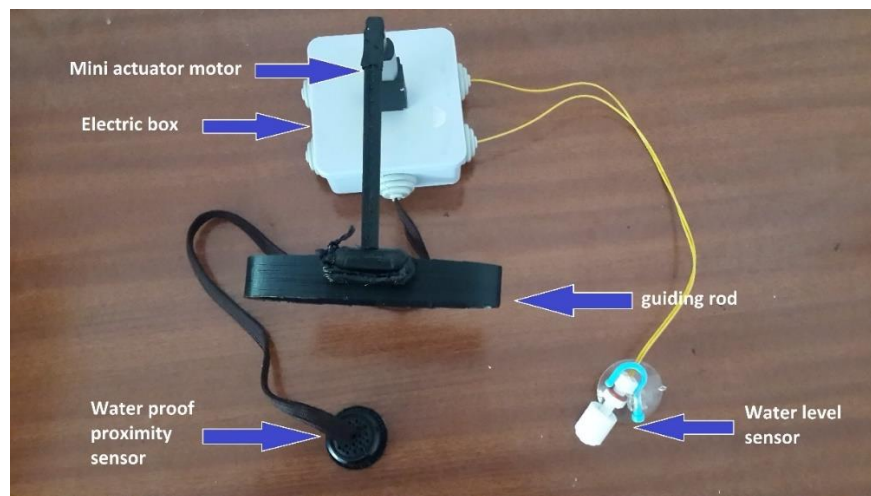


Figure 13: First concrete prototype

Source: (Author's own elaboration)

The second prototype was created as an improved version of the previous which lack stiffness and also bulky in installation in addition of the difficulties of the adaptation to water tap's dimension.

In the next prototype we replaced the used components by different ones that are more efficient and will be functional at the end of the conception.

We prepared the programme using Arduino UNO Because the board's USB connection makes it simple to connect to other computers. In addition to that, the cost is based on the Arduino UNO board. Compared to other Arduino goods, this board has the lowest prices.

The board's fixed USB port can be used as a serial device to link the board to a computer system as a power source for the board where 5V is enough for external power supply in our case. So, we can visualise the results directly in the serial monitor and instantly correct mistakes. Both digital and Analog pins are used as the C++ is object oriented.

Once the chip is programmed properly, the chips are then removed from the board and put in the waterproof enclosure as it stays tied inside and will be connected to both sensors and the actuator to perform.

Chapter 5. System Design and Technical Study

5.1. The electro-mechanical components

5.1.1. The mini actuator

The mini linear actuator offers no control or feedback mechanisms. While the voltage is applied to the machine, the actuator extends. If the polarity of the voltage is reversed, the actuator retracts. The 12 V actuator is rated for 12 V but can operate at 13V.

Table 5: Characteristics of the mini actuator [21]

Cycle time	10%, 2 minutes on, 18 minutes off
Protection level	IP54
Temperature	-10C to +50C
Noise lower than	55DB
Inner tube	Aluminium
Pull head	Plastic
Speed	5mm/s
Input voltage	12V DC
Stroke length	21mm/s

The ultrasonic sensors are suitable for detecting water as well as any liquid from every colour, whether clear or turbid. Ultrasonic sensors detect all sorts of liquid with the same distance.

According to Contrinex (2006), echo detection is dependent on its intensity, which is associated with the distance from the sensor to the object. The sensors work through the echo delay, in other word, the time between the emitted pulse and the echo reception.

When the ultrasound spreads, every barrier opposing the waves sense is detectable by the sensor. Figure 20 represents a drawing of an ultrasonic sensor operating, where you can identify the path according to the arrow that the sound makes to be reflected to the receiver.[22]

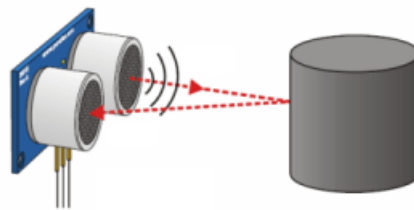


Figure 15: Ultrasonic sensor

Source (micro:bit Accessories Store from ELECFREAKS 2022)

Electric parameters

Table 7: Electric parameters of the sensor [22]

Working voltage	DC 5V
Working current	15mA
Working frequency	40Hz
Max range	4m
Min range	2cm
Mesuring angles	15 degree
Trigger Input Signal	10uS TTL pulse
Echo Output Signal	Input TTL lever signal and the range in Proportion
Dimensions	45*20*15mm

5.1.3. The Arduino UNO

Arduino UNO is a micro-controller based on ATmega328P board, is microcontroller that represents an open-source prototyping platform with easy-to-use hardware boards and software. It has 14 digital Inputs/Outputs of which 6 can be used as PWM outputs. a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button.[23]

Relevant features of the Micro-controller

Special features

- Power-on reset and programmable brown-out detection
- Internal calibrated oscillator
- External and internal interrupt sources
- Six sleep modes: Idle, ADC noise reduction, power-save, power-down, standby, and extended standby

Operating voltage:

- 2.7V to 5.5V for ATmega328P
- Temperature range:
- Automotive temperature range: -40°C to $+125^{\circ}\text{C}$
- Speed grade:
- 0 to 8MHz at 2.7 to 5.5V (automotive temperature range: -40°C to $+125^{\circ}\text{C}$)
- 0 to 16MHz at 4.5 to 5.5V (automotive temperature range: -40°C to $+125^{\circ}\text{C}$)
- Low power consumption
- Active mode: 1.5mA at 3V - 4MHz
- Power-down mode: $1\mu\text{A}$ at 3V (E.V Ebere & O.O Francisca,2013) [23]

5.1.4. TP4056

The card is equipped with an internal PMOSFET architecture and have prevent to the negative Charge Current Circuit. Thermal feedback regulates the charge current to limit the temperature during high power operation or high ambient temperature. This card allows the automatic recharge indicated by two status pin to signal the charge termination and the presence of an input voltage. Charges Single Cell Li-Ion Batteries Directly from USB Port. The charge Voltage is set to 4.2V with 1.5% Accuracy so a battery of 3.7V will be the adequate source [24].

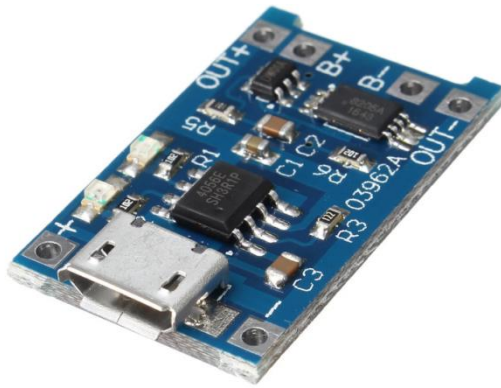


Figure 16: TP4056

Source (Standalone Linear Li-Ion Battery Charger with Thermal Regulation from NanJing Top Power ASIC Corp)

5.1.5. The DC-DC step down converter

This component allows the preservation of the amount of energy while changing its balance by dropping down the voltage while increasing the current.

This card is capable of driving a 3.0 A load with excellent line and load regulation.

Furthermore, it operates at a switching frequency of 150 KHz, thus suitable for the low consumption of the 12v battery.

The step down offers 4% tolerance on output voltage within specified input voltages and output load conditions [25].



Figure 17: DC-DC step down converter

Source (DC-DC Stepdown Module by BIGTREETECH)

5.2. Software resources

As a conceptual project, this work is naturally dependant on a set of multidisciplinary software to validate actuator concepts, microcontroller and communication parameters. SolidWorks 2021 and 2020, installed with the IPB's student license, was used to design all mechanical parts and make their assembly as well as the technical and drawing sheets such us general, main and projection views and the spare parts view.

We used as well Proteus Professional designer which contains both ISIS and ARES in order to create PCB's and to draw and simulate schematic in 3D. The circuit designed in the real experiments was

in another was reiterated and optimised through the software, so the dimension of the PCB is way reduced we just preserved minor circuits and fitted them to the optimised design such as the circuit of the Buck converter.

The design of the protection circuit will contain all the used components out of their programmers and adaptation circuit.

5.3. Microcontroller routine

When liquid Level (Ultrasonic) sensor, attached to the Arduino Uno input detects water and gets activated. The faucet gets open through the actuator mechanism.

When the water level reaches to Liquid Level Transmitter - the sensor on the bucket, based on the edge of the bucket joins its contacts and send a digital signal to the Arduino UNO that will allow the actuation of the tap by closing or opening.

The signal coming from one of the sensors will result the opening of the SLT.

The second signal will invert the polarity of the actuators poles resulting of the closure of the SLT Faucet. Both Proximity and level sensors cannot be actuated at the same time. After receiving a signal tap sensor close the tap. The delays are not considered in this proposed work as the distance between tap and bucket / tap and sink is negligible for the available wireless smart sensor. Water waste, controlling devices equipped with 2 independently working proximity sensors commanding a special open/close mechanical system to turn on and turn off a single mixer lever tap. The system is basically standing for a miniature actuator topped by a lever's collar or ring that will directly lead the lever down or up depending on the output signal. A non-corrosive metallic or 7 series aluminium alloy fixation system of collar clamp shape is also welded to the open/close system and will take place on the spout of the faucet.

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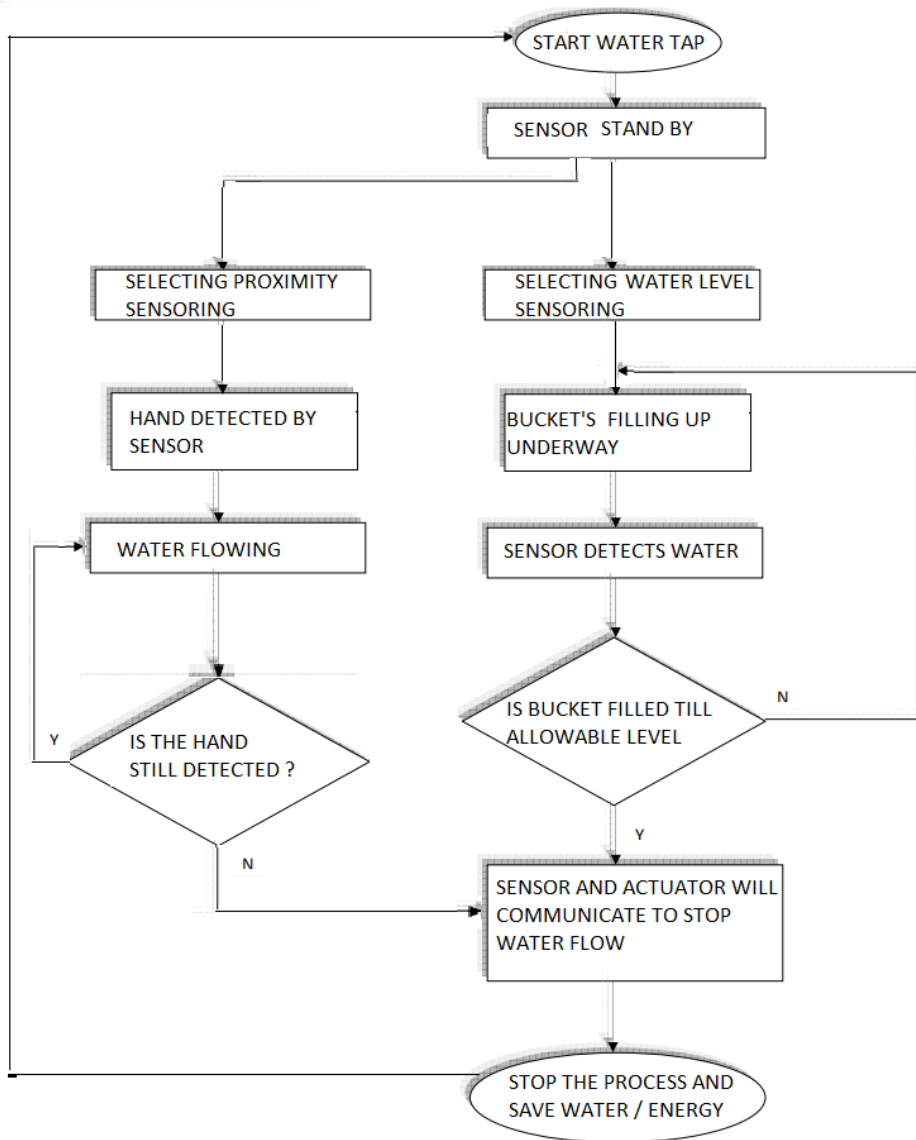


Figure 18: Flow chart diagram

Source: (Author's own elaboration)

5.4. Result

5.4.1. Mechanical design

The system (2) is equipped with a mounting bracket (6) and two screws (7) to adjust the height of the between the Handle (1) and the collar clamp (8). The screw (9) is for adjusting the collar's (8) diameter on the spout. When changing rod ends, extend the actuator completely and hold the round shaft (3) out of its sheath (4) while unscrewing the rod end. Standard lead wires are 28 AWG, 30 cm long with 2.56 mm (0.1") pitch female header connector (HiTec™ and Futaba™ compatible). The system is resistive to dust and water ingress but not fully waterproof). The protective box (11) is inclosing the infrared sensor (10) and the control circuit (12). The ultrasonic sensor (13) is protected by the Peg (14) that also insures the hanging on the bucket.

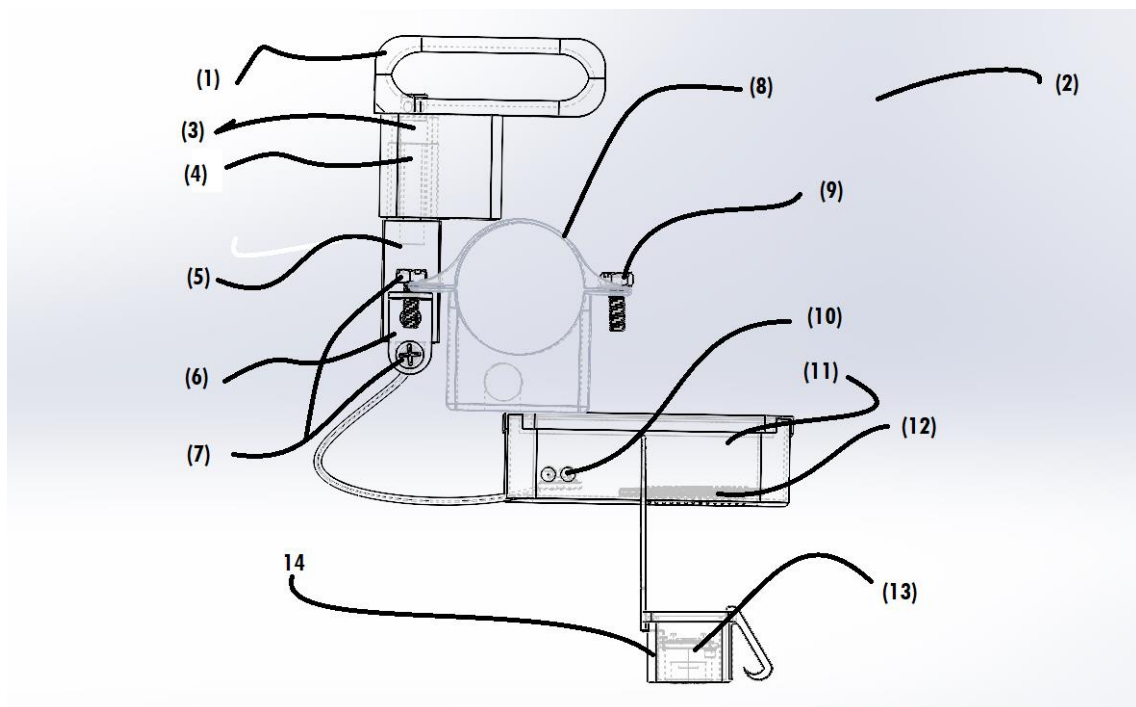


Figure 19: Numbered parts view

Source (Author's own elaboration)

Components list:

1-	Collar clamp	7-	Height adjustment's Screw
2-	water waste system	8-	Clamping collar
3-	Lifter rod	9-	Collar's adjustment screw
4-	Stable rod	10-	Infrared sensor
5-	Gearing system	11-	Electric box
6-	Height adjustments' bracket	12-	Control board

13- Ultrasonic sensor

14- Peg

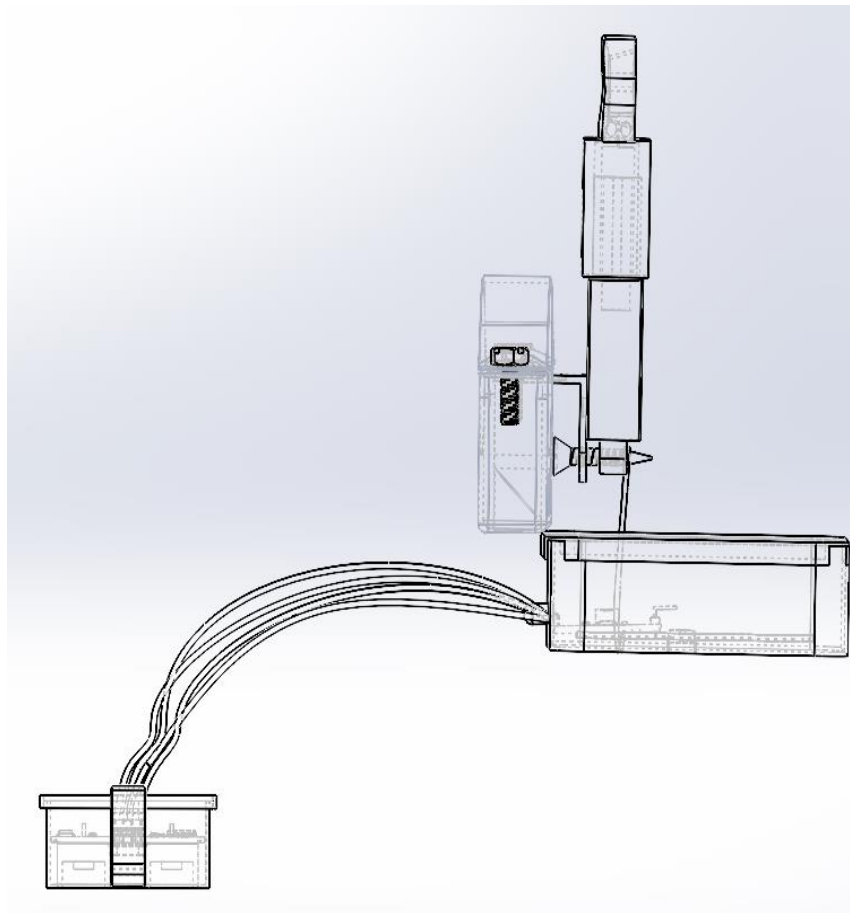


Figure 20: Right side view of the system

Source (Author's own elaboration)

Principals of work

Water waste, controlling devices equipped with 2 independently working proximity sensors commanding a special open/close mechanical system to turn on and turn off a single mixer lever tap. The system is basically standing for a miniature actuator (3), (4) and (5) topped by a lever's collar (1) or ring that will directly lead the lever down or up depending on the output signal coming from the control board (12). A non-corrosive metallic or 7 series aluminium alloy fixation system of collar clamp (8) shape is also welded to the open/close system and will take place on the spout of the faucet.

The device is appropriate only for domestic use.

When installing the device, pay attention to close tightly the clamp on the spout of the faucet.

The water tap's lever controller is designed to push or pull the faucet's handle (1) respectively, when opening or closing along its full stroke length. The speed of travel is determined by the gearing (5) of its actuator and the degree of stiffness of the handle or force. The actuator is working against at a given point in time (see Load Curves chart in the figure 8 and 9). When power is removed, the system

goes out of function and holds its position, unless the applied load exceeds the back drive force, in which case the actuator will back drive. Stalling the device under the power of the order of a few seconds will not be object of damage arising in Its electrical system. Do not force manually or out of tension the mechanical system (3) or the Handel (1) which can lead to an insured internal damage to the actuating system.

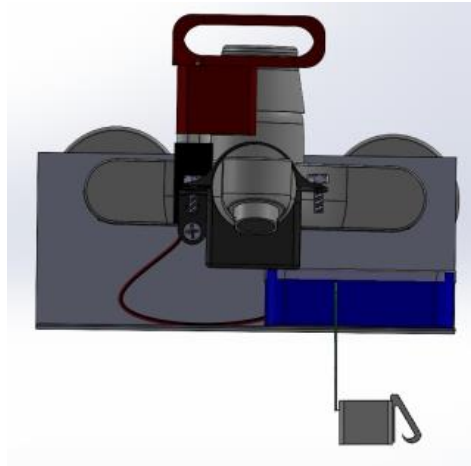


Figure 21: Water saving system

Source (Author's own elaboration)

5.4.2. Circuit design

As a result, the circuit combining sensors with Arduino Uno and the actuator using breadboard was established in the figure 10 the Arduino Uno will be replaced in the following circuit in figure 33. The circuit was professionally made on a Proteus 8 professional as we can see in figure 34 which the design is shown in the figure 35.

The final concrete prototype machine is portrayed in the figure 36 while the schematic circuit is brought in the appendix.

This task consists of the realization of the printed circuit on the ARES software and its printing on a plate, we had assumed to carry out this task in three days. Build the power supply circuit and carry out a few tests to check that it is working properly. The estimated working time of the machine is 3 hours in continuous working. The mounting is done on the following way:

- The ultrasonic sensor is connected to pin 17 and 16 of the ATmega or respectively 11 and 10 for the Arduino.
- The infrared sensor is connected to pin 4 of the ATmega or pin 2 of the arduino.
- The bridge H is connected with the ATmega by these two pins 1 and 2 with pins 6 and 10 of the ATmega respectively.
- We use pins 3 and 6 to connect to the actuator pins.

- The H bridge is connected to the DC DC converter with pin 8 in order to receive 5v. Pin 16 must imperatively be connected to 12V.
- A second buck converter is mounted on the 5-volt pin of the ATmega so as not to destroy the circuit by the intolerant 12v voltage, the regulator will also be connected with the TP4056 loading module equipped with its DW01A protection module.

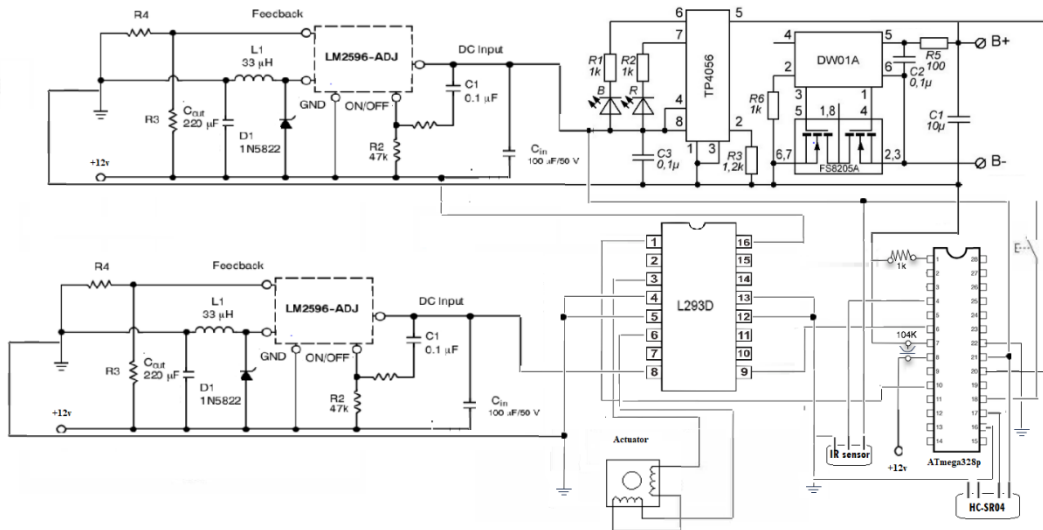


Figure 22: Electronic circuit drawing manually

Source (Author's own elaboration)

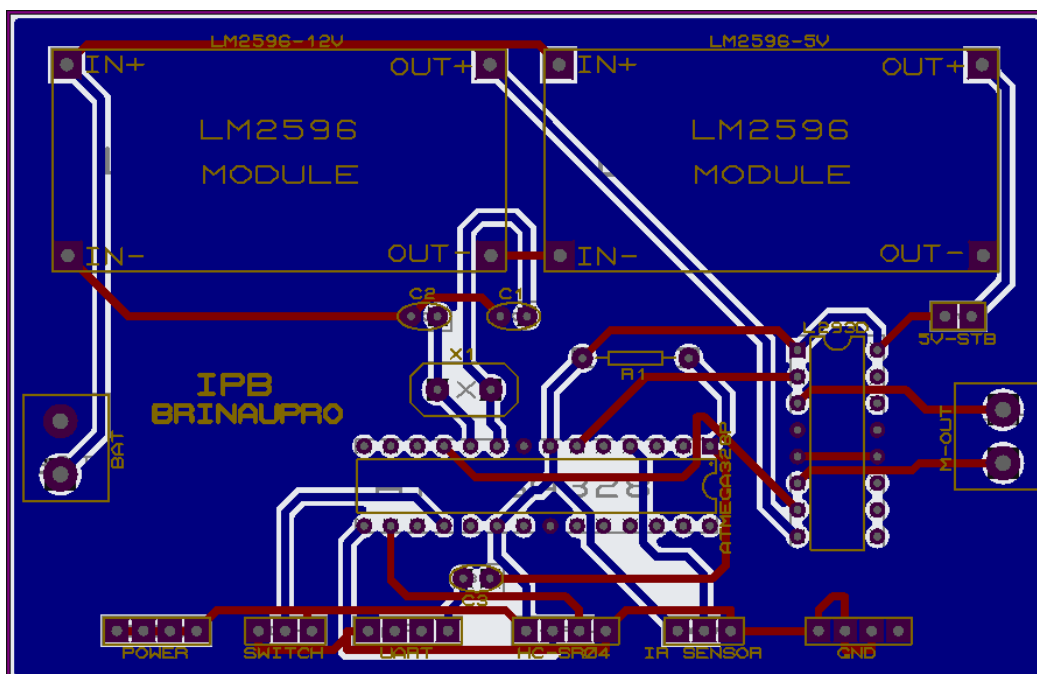


Figure 23: PCB connexions

Source (Author's own elaboration)

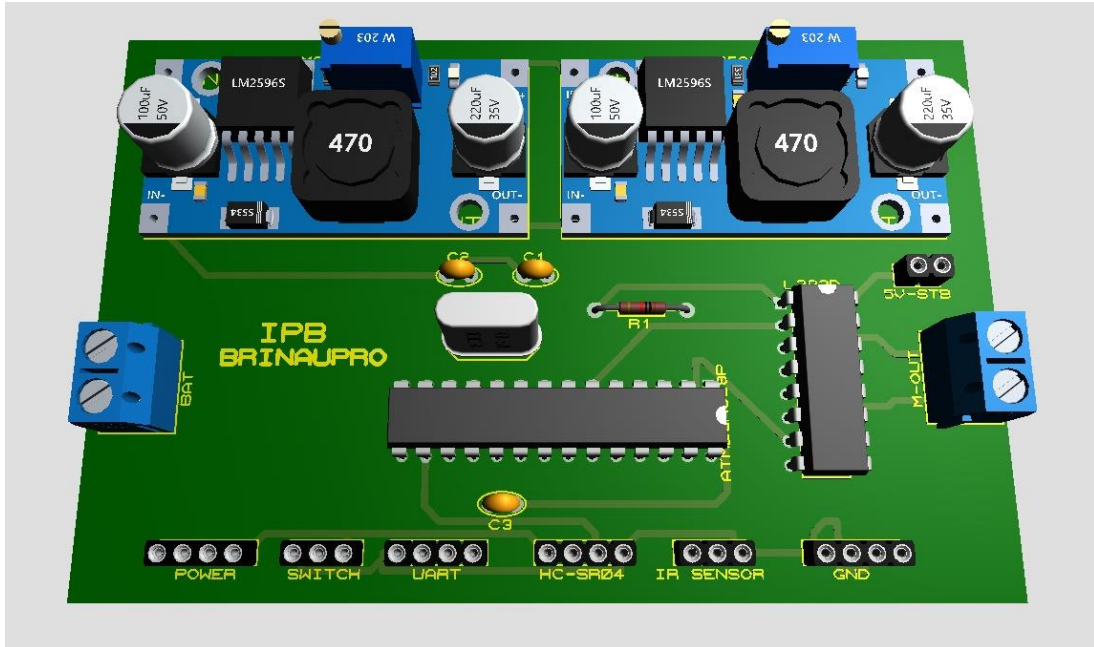


Figure 24: 3D PCB simulation

Source (Author's own elaboration)

The prototype below was created in LCAR_lab in IPB as some of the components such as the Arduino card, the Buck converter and batteries were provided in order to insure the creation in worthy environment.

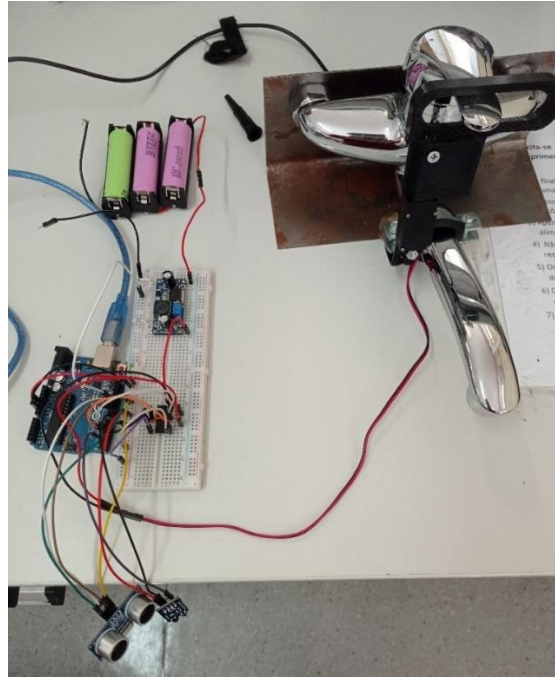


Figure 25: The prototype

Source (Author's own elaboration)

The final prototype was made with by soldering all the through hole components and a drilling the electronic box in order to connect the inner components to the outside, then make it clogged with hot glue that is non-current conductor in order to avoid short circuits among components. In the frame of a paradigm, we used the called 'lamp's cover' to represent the bucket. As we can see in figure 27 the cover was taken out to see the entire connection of the system

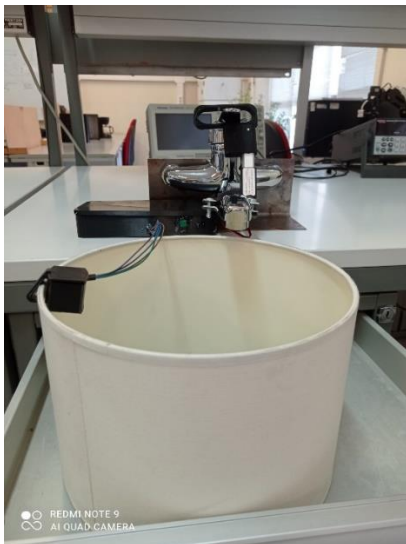


Figure 26: The final prototype

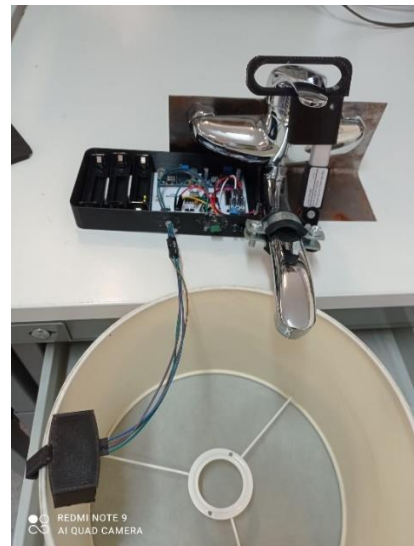
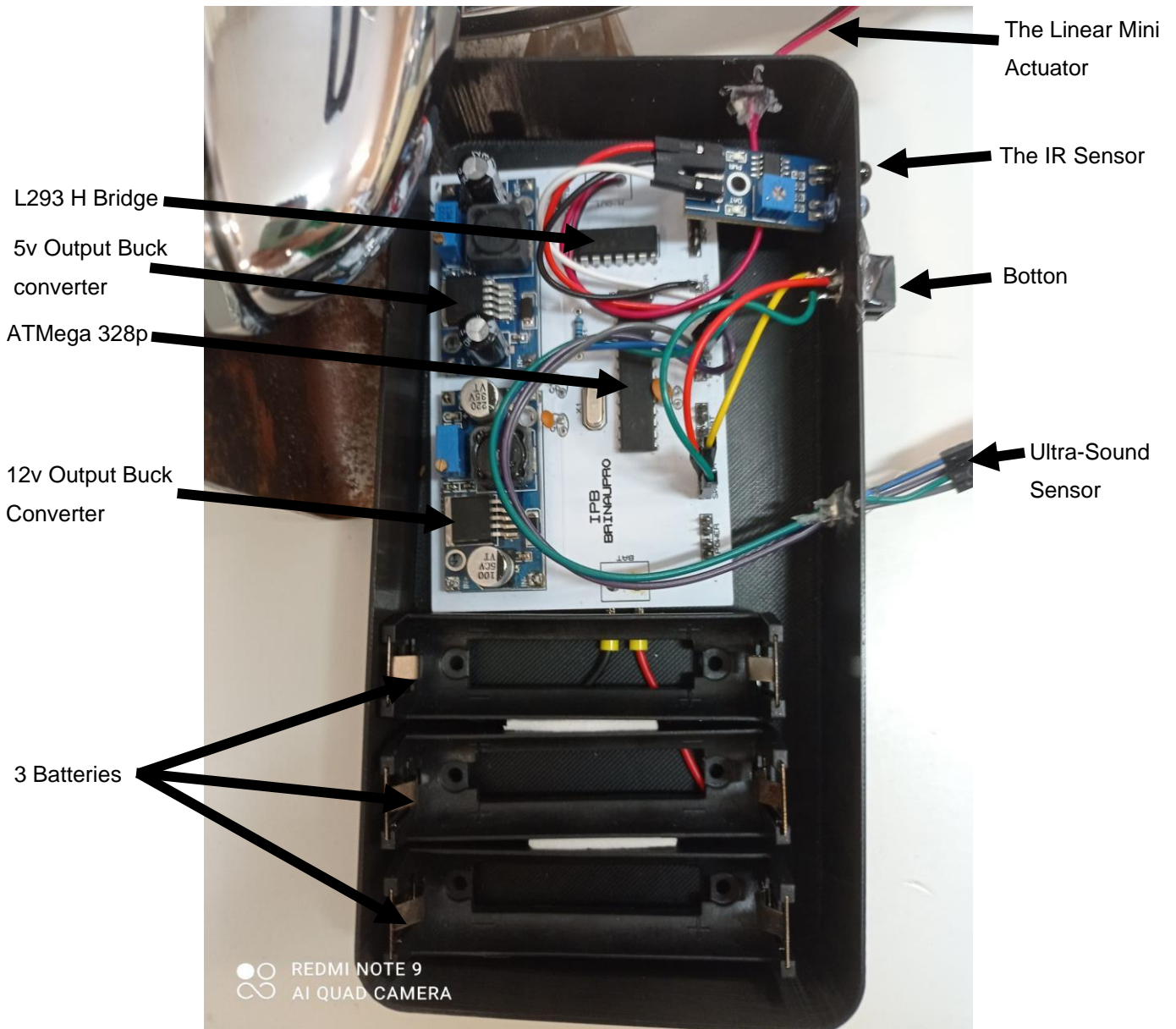


Figure 27: The electronic box

Source (Author's own elaboration)



5.4.3. The program

The program was written in C++ which is the Arduino language of the programmer. The content is broken up into functions called inside the main program that is "void loop" all the variables were declared by their type of data. The transition between the different sensor program is facilitated through the constant Bton. The output from the which the signal is sent to the actuator is EN1 and EN2 connected to the H Bridge L293 in fact as seen in the circuit design previously.

Chapter 6. General Conclusion

The sole intention of this research work was to establish a flexible, economical, and easy configurable system which can solve our water losing problem. Existing tap and washbasins can be equipped with such system to have economical use of water. The idea is based on a combination of two available function noticed in two products already in the market which can be a siege of an innovation using several possible approaches and a broad variety of tools. Subsequently to this research, the study has the objective to relate the conception of the supervising system to the business study of the device that will complete the innovation of product and insure the process.

To this end, this work first ensured a proper functioning of a system that is very close to a product or more to a Prototype that is not yet suggested in the market. Eventually, the financial and business plan will prove the feasibility of the business as the technical study has proven the concretisation of the idea before. In the future, companies can adapt and improve the suggested solution by changing some inner components to enhance the function and reduce the effective cost.

One of the relevant points of the technical study was the two sensors used in the project which are the Ultrasonic and the infrared sensors are both chosen of the aim of investigation and research only and where presenting a challenge of us as we realise the first circuit of supervising adding such sensor working respectively with digital and analogic input and can be a reference to other researchers building there thesis or in their theories since no relevant project when embroiling these both since we faced difficulties to synchronise the sensors at the same time.

The system can be improved by using wireless sensor or adding a connecting module to the HC-SR04. The ultrasonic sensor can be used in a smaller dimensions and better shape more suitable for sticking to containers.

Otherwise, we can assume that the level sensor can be improved through a simpler technique and less cost which consists of detecting the liquid by electric conduction through water.

For the same purpose, it is applicable to emerge the electronic part inside one Mold which will have a unified form as a device and reduce the bulk of the device. It is possible to make the level sensor programmable by the users as i can be quickly and practically adjusted to detect a defined level. It's also possible to reduce the space of the electronic layout as the ATmega328p can be directly added the circuit programming it instead of the whole card. The machine's design can be reproduced in a more suitable way.

The business plan was a minimise strategy, but also based on realistic scenarios and calculation done by the software providing minacious values in table form. The plan is possibly improvable, and factors are easily able to change to adapt the business with a 2nd part or a partner according to its policy.

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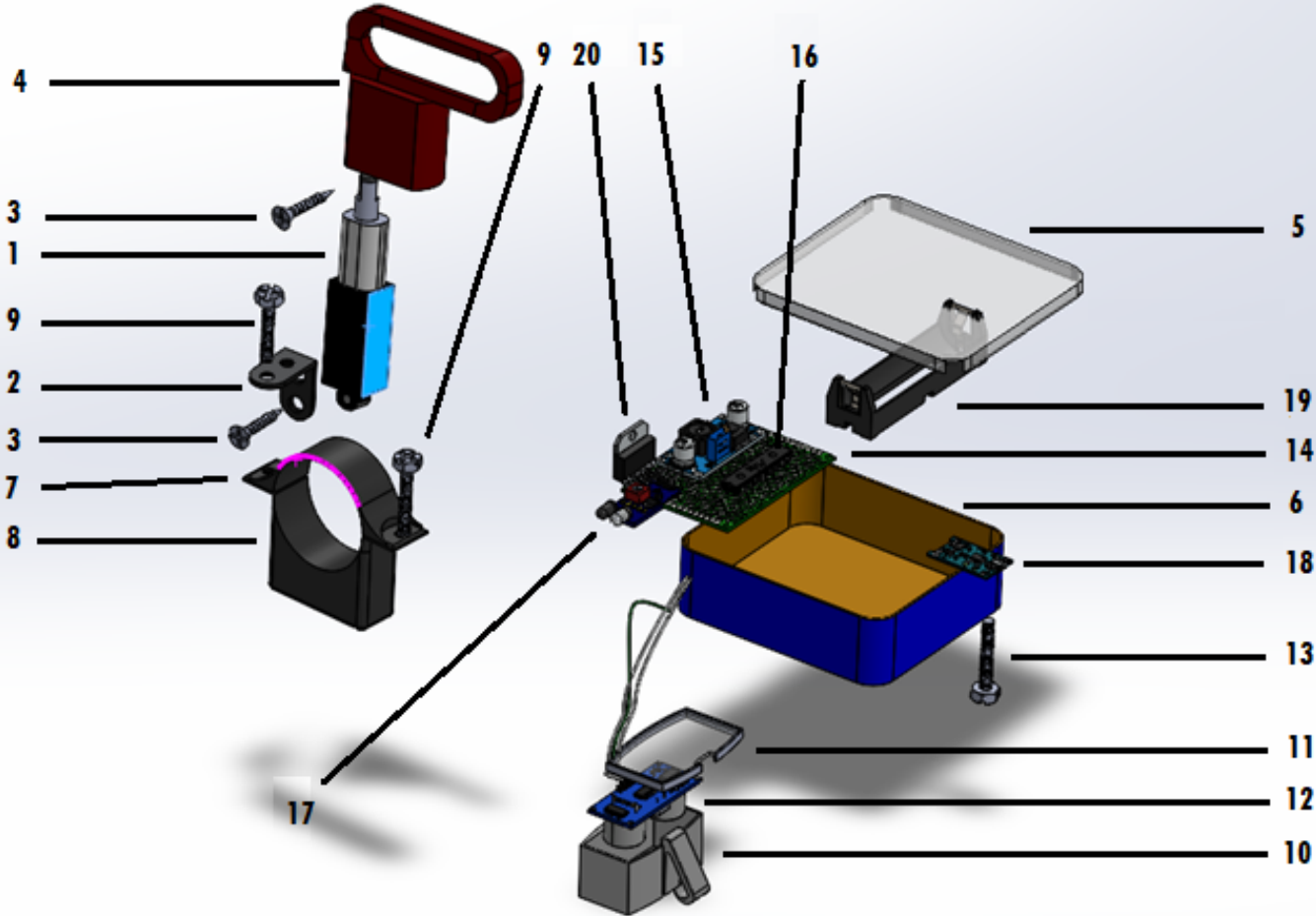
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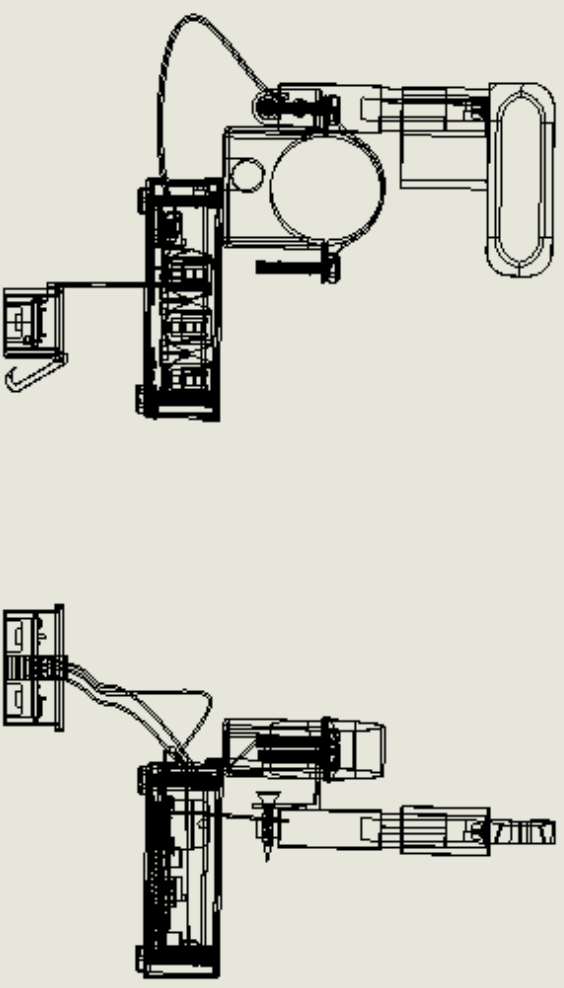
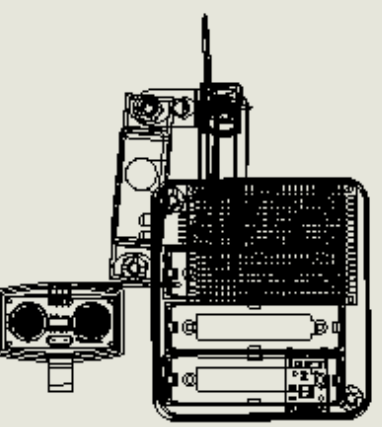
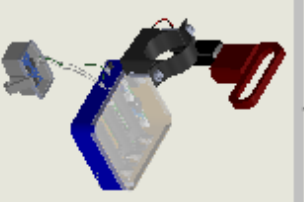
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Appendix



ITEM NO.	DESCRIPTION	MATERIAL	QTY.
1	Linear Actuator LA-M-12-40-30-30 85		1
2	bracket	Bracket fixation, Black Metal	1
3	bolt for collar 4mm	STEEL CX33A	2
4	knob	POLYETHYLENE UHMW	1
5	lid for box of components	Diecast aluminium ADC12	1
6	box for components	Diecast aluminium ADC12	1
7	collar upper part	POLYSTYRENE RENOLITE	1
8	collar lower part	stainless steel 4mm grey	2
9	Charging module TP4056		1
10	sensor peg holder	Plastic	1
11	lid for the peg holder	Plastic	1
12	ultrasonic sensor hc-sr04.step	C 12 H 10-x Cl x	1
13	bolt for electric box		2
14	lid of the peg holder	plastic	1
15	nails for actuator 4mm	stainless steel 4mm grey	2
16	PrototypingBreadboard_15*7cm.stp	SiO2-Al2O3-CaO (0.6 wt%)	1
17	DC-DC Buck converter	polychlorinated biphenyl, copper, plastic, steel	1
18	atmega328-alone.step	acrylate-based emulsion copolymer.	1
19	IR Sensor	polychlorinated biphenyl, copper, plastic, steel	1
20	recharging module TP4056	polychlorinated biphenyl, copper, plastic, steel	1
21	DC-DC converter LM2596	polychlorinated biphenyl, copper, plastic, steel	2
22	18650 Single Cell Holder	1.UL 1007, 26AWG, 150mm wire 2.solder lugs 3.PC pins	3
23	H Bridge L298	acrylate-based emulsion copolymer.	1



scale : 1:2.3

material : steel and plastic

university : Instituto Politecnico de Braganca

Ahmed Kchok

TITLE:

water saving system

date: 17/08/2022



A3

