Parents of the Future

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ECE445 Project Proposal- Spring 2019
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1. **Introduction**
    a. **Objective**:
        i. **Problem Statement:** How can parents monitor their child's chores in a time efficient manner? Currently, our economy does not provide a single accessible tool for parents to use. Parents come home from a eight hour work day and average a one hour commute, in a country where the average family lives paycheck to paycheck, just to come home to seeing overflowing trash bins, sinks and laundry bins? And to top it off, the kids hate doing chores? What could possibly solve this?
        ii. **Answer**: Parents of the Future. Now for the first time in a post Victorian era, Parents will be the Kings once more. Parents will have access to full real time statistics regarding whether the chores are actually being completed or not in the form of a website, and kids will have fun completing the chores due to a points based competition system to see which kids are the best at completing chores.
    b. **Background**:

Chores nowadays are becoming harder and harder for the modern American family to implement into their lifestyle. It is a complicated problem that stems from both social and economic strains. In certain households, such as part time dual earning households, the children do virtually zero chores [5]. To compound the difficulty of implementing chores, by the 1980's the predominant American family became a two wage family with young children [6]. With both parents having to fulfill demanding corporate lives, the time spent with children is also strained and limited [6].

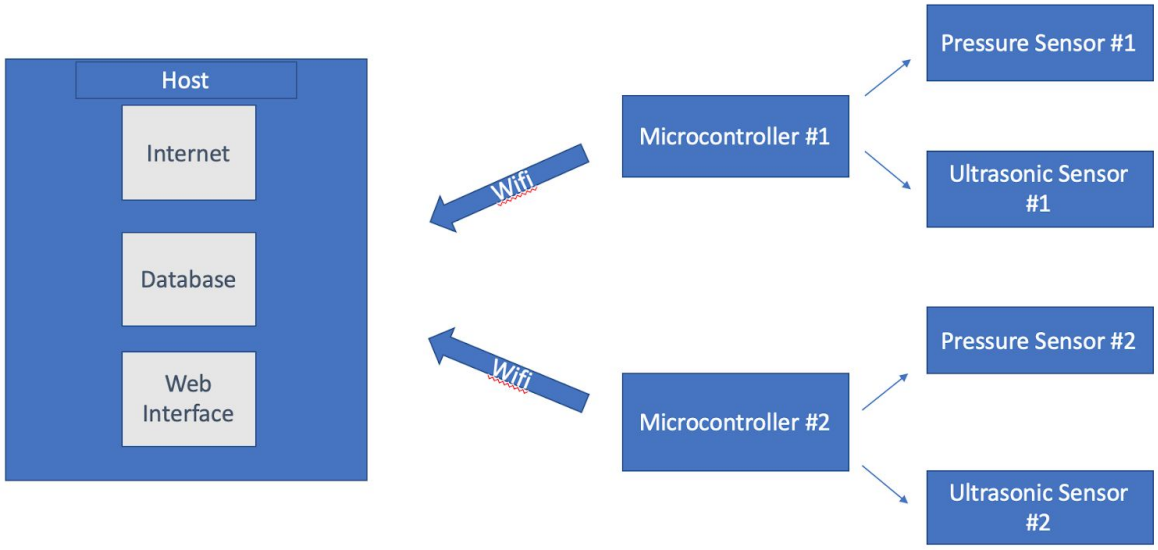
With less time for parents to interact with their children, the need to make a positive impact with allotted resources is ever growing and present. Children are generally perceived as source of most conflicts in American households, an attitude that generally makes them less likely to agree with parents [4]. Healthy chores are the solution to all the problems listed above, and Parents of the Future can not only allow parents to efficiently and positively interact with their children but can also mend false parenting beliefs.

    c. **High-level requirements list:** A list of at most three *quantitative* characteristics that this project must exhibit in order to solve the problem. Each high-level

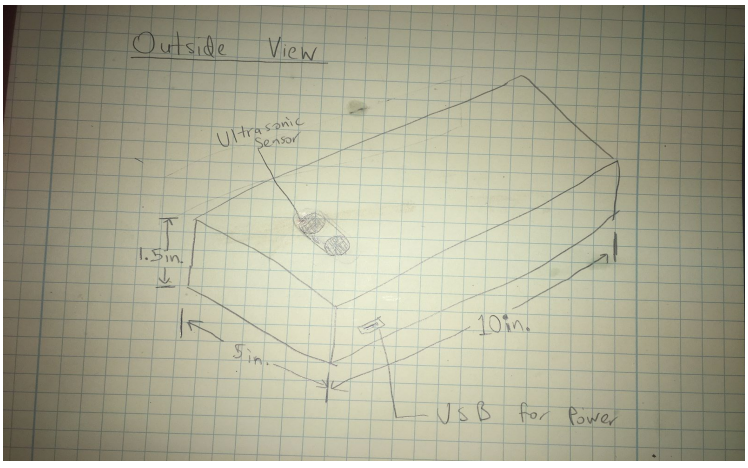
requirement must be stated in complete sentences and displayed as a bulleted list

i. Functionality. The project must be stress tested to work properly. Quantitatively, this means a consistently low latency system that meets the five nines standard.
ii. Ease of use. This product must be widely useable and convenient for families to incorporate in their homes.
iii. Safety. This system must be stress tested and designed to have the most infinitesimal probability of causing any life threatening circumstance.

2. Design
   a. **Block Diagram:**



   b. **Physical Design (if applicable):**



The physical design of our product will be stylistically focused as we are trying to produce something marketable and viable. This is the reason why the thickness will be a minimal 1.5 inches, which will be enough to fit the ultrasonic sensor and our PCB design. The logic behind the 5 inch side is taking into account the average household garbage can size as a major factor for the maximum size of that dimension. The last side featured the most flexibility so we decided to go with 10 inches to provide ample space for the PCB and the air- flow with the circuitry.

c. **Functional Overview:**

Host Functional Overview:

The host has three sub components: internet, database and web interface. The host is the family's host computer that will run the network application. The backend will most likely be written in Python for ease of use data scraping from the database, the database will be MySQL and the front end will be node.js and Javascript to develop the web interface. This is all contingent on a working internet connection to create wifi connectivity between the host and the microcontrollers.

Internet: Internet is super important since without it there is no way for the data to stream to the web interface. This design is contingent on the family having working internet and wifi compatible internet to connect to the microcontrollers.

Database: Our initial design involved using a linux client server network, which required a microprocessor. This led to a higher cost, and we looked for ways to reduce the cost of our product so that the average family could easily purchase it. A design to remove the microprocessor and achieve the same high level goal is by replacing the microprocessor with a database and implementing wifi connectivity on the microcontroller chips. The database will be MySQL with the potential usage of Aurora MySQL if we choose to use cloud computing for storage.

The backend will be written in Python, and will scrape and format the data from the database and plug the data into the front end. The front end will be a web site running on a local port.

Web Interface: The web interface will be written in Javascript and node.js, and it will implement all the aspects of the product that the consumer will see. Alongside real time statistics from the sensors, it will also implement the "fun" aspect of the product so that the children can enjoy completing chores. We will use a Guardians of the Galaxy themed ELO system for the child to see how well they are doing. We haven't figured out the exact benchmark elos yet, but the system will be calculating how well the child is doing and give their ranking in the form of a Guardians of the Galaxy character.

Microcontroller Hardware: The microcontroller will be an important part of the design as it will handle inputs, which in our case will be the ultrasonic and pressure sensor. This means that we will have dedicated pins on our PCB that deal with the input of data from the connected sensors. The microcontroller will also be connected to our power supply, and act as a power source for the chips contained on the PCB and sensors. The microcontroller PCB will contain a ESP8266 Wifi Chip, which will be used as a transmitter and receiver in our design. The Wifi

Chip has lower power infrastructure and can be used in different power- saving modes. The main chip that we will use to interconnect all our surrounding hardware will be the ATmega328P. This chip also has a built in Analog- to- Digital converter, which is needed because the data provided by the sensor is Analog and Computers interpret Digital data. There will be several female heads on the PCB to allow for the connection of the sensors to the ATmega328P chip. The ESP8266 Wifi Chip will be responsible for interfacing the hardware aspect of the design with the software used for the control and management of data.

Pressure Sensor: The pressure sensor would be placed at the bottom of both the trash can and the laundry basket. This sensor acts as one of the two cases we have to check whether the laundry basket and trash can is actually full. Weight is determined by this sensor and after a certain weight has been reached, the laundry basket/trash could be full. The sensor should be able to detect weights upwards of 20-25 lbs. The data collected from the sensor is then sent to the microcontroller to compare with the data from the ultrasonic sensor to finally determine if the laundry basket/trash can is actually full. This sensor is powered by the microcontroller and sends Analog data to it for interpretation.

Ultrasonic Sensor: The ultrasonic sensor would be placed at the top of both the laundry basket and the trash can. This sensor also acts as one of the two cases we have to check whether the laundry basket is actually full. This sensor can determine if trash/dirty laundry has reached a certain height specifically at the center of the laundry basket/trash can. Once the height requirement in the laundry basket/trash can is reached, data is sent to the microcontroller for interpretation. The way this sensor determines whether the height requirement is met is by making sure no obstacle exists in its path. The presence of an obstacle would shorten this distance, indicating that the height requirement has been met. This sensor is also powered by the microcontroller and the data collected from the ultrasonic sensor is compared with data from the pressure sensor to finally determine is the laundry basket/trash can is actually full.

d. **Block Requirements:**

<u>Internet:</u>

1. Needed to power the networking aspect. Connects to microprocessor and microcontrollers via the power cable.

<u>Host Linux OS:</u>

1. Can be any Unix based linux operating system. The best choice is Alpine, because it is lightweight and designed for networking.
2. Set up and torn down via a Docker image launching an instance in a Docker container.
3. Will run a Linux Server. Our current choice of server is iPerf3 due to how lightweight it is, but we have a multitude of options.
4. Will create a local website by connecting to the

Microcontrollers:

1. Use the general purpose input/ output pins to read the pressure and ultrasonic sensors.
2. Sole purpose is to interface the sensors with the microprocessor. This information is then transmitted to the host computer, where the information is displayed on the local web interface.

Pressure (Force) Sensors:

1. Should be able to accurately determine the weight applied to the sensor.
2. Ability to detect weights upwards of 20- 25 lbs.

Ultrasonic Sensors:

1. Ability to detect objects at the center of the container and use this info to determine if container is full.
2. Detect and determine whether a container is empty.

e. **Risk Analysis:**

We believe that the Microcontroller will pose the greatest risk to the completion of the project as it acts are the medium between the hardware components and the software. The fact that we are creating a microcontroller on a PCB has the ability to cause some problems because of the lack of experience and timelines associated with the process. I believe that the design of the PCB will be critical as we need the proper input/ output pins and chips to allow the use of two sensors and a wifi chip. The unsuccessful completion of this block would mean the software controls and data collection wouldn't have the sensors to gather data and echo to the software.

3. **Ethics and Safety**

There exists a number of potential safety hazards based on the way our system is implemented, specifically, the usage of lithium ion batteries. One of the safety concerns surrounding lithium ion batteries is the fact that it should not make contact with water under any circumstances [2]. Since the design involves a laundry basket and trash can, special arrangements regarding water do not have to be made. However, it is important to be aware of such precautions in case wet hands or wet clothes were to make contact with the battery or physical circuitry in general. Besides, it is also important that lithium ion batteries are kept within the safe operating limits when being charged. These safety rates are important to pay attention to because drawing too much current from the charger can potentially cause a fire. To mitigate this risk, lithium batteries used must be of trusted quality as most of them have incorporated circuitry built for protection to ensure safe operating limits [1]. Being electrical engineers, we are expected to abide by the IEEE Code of Ethics and Code #1 states that we agree "to hold

paramount the safety, health and welfare of the public" [3]. Therefore, we are responsible for making sure users are not harmed when using our product. In addition to that, by choosing to use a certain battery to be used in our product, we are accepting responsibility to ensure the battery matches the demands of our product. To mitigate the risks mentioned, the battery and necessary precautions that need to be taken for user safety will be continuously tested to ensure safe usage.

Besides the safety issues that have been mentioned, there are some minor ethical concerns that will be addressed. We are responsible for the data collected indicating whether the chore needs to be done and it has to be accurate to ensure the integrity of this project. This is in accordance to Code #3 in the IEEE Code of Ethics that states that we agree "to be honest and realistic in stating claims or estimates based on available data" [3]. Tests will be conducted to make sure sensors accurately collect and transfer data to the created mobile application. In addition to this ethical code, we will be open to constructive criticism of faults in our implementation from peers, course staff and industry professionals. This idea like many other ideas out there is not perfect and will be susceptible to criticism that will in turn help in the making of a remarkable product. This reiterates Code #7 of the IEEE Code of Ethics that ensures we agree "to seek, accept and offer honest criticism of technical work…" [3].

References

[1] Ian Poole, "Lithium Ion Battery Advantages & Disadvantages". [Online]. Available: https://radio-electronics.com/info//power-management/battery-technology/lithium-ion-battery-advantages-disadvantages.php [Accessed: 5- Feb- 2019]

[2] Panasonic, "Safety Precautions for the Lithium Ion Batteries". [Online]. Available: https://genuinecells.com/safety-precautions-for-the-lithium-ion-batteries [Accessed: 5- Feb- 2019]

[3] Ieee.org, "IEEE IEEE Code of Ethics", 2019. [Online]. Available: https://www.ieee.org/about/corporate/governance/p7-8.html [Accessed: 5- Feb- 2019].

[4]. Googins, "Vulnerability of Working Parents: Balancing Work and Home Roles" , *Social Work,* 1987. [Journal] Available: https://academic.oup.com/sw/article-abstract/32/4/295/1888648 [Accessed: 5- Feb- 2019].

[5]. Smetana, "Adolescents' and Parents' Reasoning about Actual Family Conflict", Child Development, 1989. [Journal] Available: https://www.jstor.org/stable/1130779?seq=1#page_scan_tab_contents [Accessed: 5- Feb- 2019]

[6]. Benin, "Adolescents' Chores: The Difference Between Dual- and Single-Earner Families", Journal of Marriage and Family, 1990. [Journal] Available: https://www.jstor.org/stable/353032?seq=1#page_scan_tab_contents [Accessed: 5- Feb- 2019]