**PARENTS OF THE FUTURE (SPRING 2019)**

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**1. INTRODUCTION**

**1.1 Objective**

**(a) Problem Statement**

A lot of times, both parents (or the only parent, in case of single parents) of the household tend to be working for some number of hours a day, and have to leave their children alone at home. It is not always possible for the parents to keep track of their children’s chores in real time.

**(b) Solution**

We would like to build a surveillance system that records video data and uses computer vision algorithms to identify objects/people in it at strategically placed cameras, and alerts parents when it detects that the children have been doing their assigned chores.

The original project that we are referencing sought to build an IoT based system that would help parents monitor the chores done by their children, using weight sensors in the sink, the trash can and the laundry bin, and building a local network between the sensors and the parents’ computers. We would like to implement the functionality of this project by using visual surveillance, by adding vision sensors or cameras, and placing them near the doors or rooms where the chores (laundry, trash and dishes) are to be carried, and connecting their output to a laptop, which would run computer vision algorithms to detect whether a task has been completed, which would then be transmitted as an update to the apps on the parents’ devices.

**1.2 Background**

Today, most American families are such that both parents have little time to spend with their children, and the number of single parents has also been on the rise since the 1970’s. As a result, parents might need additional help in keeping track of their children and their activities. Hence, we would like to build something that would allow parents to track their childrens’ activities, so that they may spend the time that they DO have with their children in other ways, such as homework or emotional bonding.

**1.3 Physical Design**

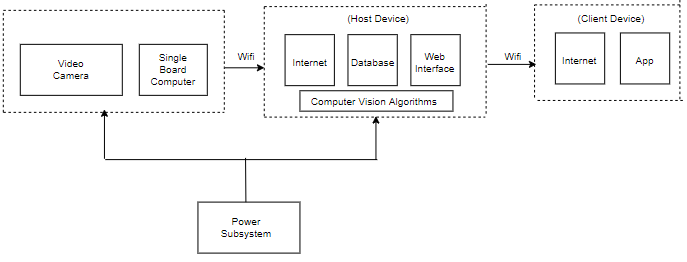
Our design consists of 3 different types of components:

(a) The camera and Single Board Chip Computer (to transmit video data via wifi to a main computer)—there will be one such unit for each surveillance point in the house (trash, dishes, laundry)

(b) The power subsystem to supply power to the camera and SBC subsystem, as well as the main computer/Host Device subsystem

(c) The main computer (to run the computer vision algorithms and to update data on the app over wifi)--labelled as Host Device in the diagram

(d) The parent devices, which can download the apps in order to see the status of their homes, labelled as Client Devices in the diagram



**1.4 High Level Requirements List**

The high level requirements will be as follows:

1. To recognize the children as they enter the field of view of a video camera with 75% accuracy
2. To recognize that the task has been completed with 70% accuracy
3. To update the information to the parents’ device apps in real time with 90% accuracy

**2. DESIGN**

**2.1 Block Diagram**

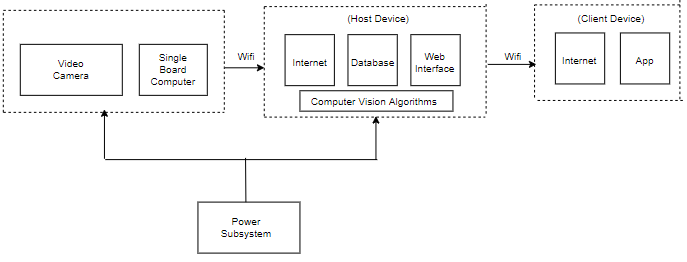
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Figure 1: Block Diagram

**2.3 Functional Overview and Interface**

**(a) Camera and SBC Subsystem:** this will consist of cameras placed at certain locations in the home, such as in the kitchen, in the laundry room, and the room containing the trash, which will collect video data that will then be processed by the computer. This data will be transmitted to the processing subsystem via a single board computer (Jetson Nano), which includes a wifi chip, both of which will be a part of this subsystem. There will be one unit of this set up for each chore.

**(b) The power subsystem:** this will consist of the wires and power sources required to power the other subsystems in this project.

**(c) Processing Subsystem:** this will consist of the main computer present in the home which will run video and image processing algorithms to detect the unwanted objects, happenings or people in the apartment. This will take in camera input, and will also generate the signals to be updated on the apps on the parents’ laptops, tablets or smartphones (complete and incomplete chores). This is the actual “brain” of the project, and will be used to fulfil all the high level requirements of the project. However, it will rely heavily on the other components of the project.

**(d) Client Device:** this pertains to every parent device that the parents would like to use to access the chore monitoring system app.

**2.4 Block Requirements**

**(a) The camera and SBC subsystem:** there will be 3 of these in our system.. This subsystem is important because it will help us collect video data which will be processed by our computer vision algorithms in the main computer. These will transmit data to the main computer via wifi. These will need an input of 5V +/- 0.1V each.

**(b) The power subsystem:** this will contain the main power source from the central power supply in the home, as well as the wiring and voltage regulators that will step down the home voltage to 5V in case of the camera and SBC subsystem, and provide full voltage to the computer. This system requires a steady input of electricity from the home electric supply at all times to function successfully.

**(c) Processing Subsystem:** this contains the main computer that will run computer vision algorithms. We intend to use the following ROS/ROS friendly libraries to achieve successful computer vision:

(i) face\_recognition to detect facial recognition from video data stream

(ii) openCV to recognize tasks being completed

(iii) a “wrapper” python program to generate all required signals and update them on the app back-end and database

This computer will need a steady power supply of 120 V, which will come from the home electric source/power subsystem, without which it will fail to work.

**(c) Client Subsystem:** this will contain the front end app, which will be developed on another computer(one of the team members’ laptops), and launched on the Google Play and Apple app stores. These apps will have a user interface that will display the signals that will be updated to the back end in real time. The only requirement for this subsystem is that it be charged at the time that the parents would like to track the app, and also that it be connected to a reliable internet/wifi source.

**2.5 Risk Analysis**

The most critical subsystem of the project is actually the power subsystem, since none of the components will work without electricity. However, since America has a very reliable utility supply, we can assume that this will not be a problem.

In that case, the critical camera requirements will be met, so we can assume that those will function correctly as well (atleast during the warranty period, and assuming no manufacturing defects).

Hence, the software algorithms will be critical to the performance of this project. They will have to make sure that the data is processed quickly in real time in a streamlined and efficient manner, and the python code will have to make sure that it is updated correctly.

**3. DISCUSSION OF ETHICS AND SAFETY**

One major issue that this project could face is that the video data could be intercepted by malicious third party content, which would be a violation of sections 1.2 and 1.6 of the ACM code of ethics[1], titled “Avoid Harm” and “Privacy” respectively. To avoid this, we will encrypt the data from end to end, so that it cannot be used maliciously even if the system is intercepted.

Since this project is heavily reliant on electricity, several electric safety measures wil; have to be followed, to avoid causing injury or harm to the members of the household or guests who may come in contact with it, in order to be in line with the IEEE code of ethics[2], entry 9. We will make sure to ground each electrical component, and also place it on rubber or wood in order to insulate it.

**5. CITATIONS**

[1] “The Code Affirms an Obligation of Computing Professionals to Use Their Skills for the Benefit of Society.” Code of Ethics, [www.acm.org/code-of-ethics](http://www.acm.org/code-of-ethics).

[2] “IEEE Code of Ethics.” *IEEE*, www.ieee.org/about/corporate/governance/p7-8.html.