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Cosmic Cube – Requirement Specification

Date	Revision #	Author	Comments

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1. Introduction

This document will outline the requirements and specifications of the cosmic cube project.

2. Overview of the Design Team

The group assignments are as follows:

Team Leader – Kenneth Spradley

The Team Leader will manage the progress of the project. They will ensure that each member of the group is on task and has what they need to succeed. The Team Leader will also guide/setup the team meetings as well as manages disputes.

Lead Programmer – Kenneth Spradley

The Lead Programmer will take on the programming for the project.

Lead ECE – Matt Gibson

The Lead ECE will take on the electrical parts of the project. The Lead ECE will also record team meeting minutes as well as take notes of the team meetings.

ECE Assistant – Don Lundi

The ECE Assistant will assist the Lead ECE. They may also assist the Lead ME where applicable.

Lead ME – Cole David Gray

The Lead ME will hand the mechanical, structural, and drawings for the project.

Financial Advisor – Crystal Hill

The Financial Advisor will be in charge of the funds as well as ordering of materials. Ordering supplies will be done through the Financial Advisor.

3. Needs Analysis

3.1. Overview of the Cosmic Cube Project (Purpose)

The purpose of this project is to build a cosmic ray detector. This detector will pick up particles of extremely high energy, called cosmic rays, when they pass through the cube of the detector. The detector unit will be a compact self-contained cube shaped device that should be able to detect primarily muons, electrons, and protons. This cube should be able to be reproduced to build a matrix of cubes that will connect together to relay more pertinent information. These cubes will be connected to a microprocessor that will process the information to be relayed to the user.

3.2. Statement of the Problem

There is a need to detect high-energy cosmic rays because although research has been done regarding the subject, the exact origin of these extremely high-energy particles is not exact. Detecting these cosmic ray showers on earth and recording the presence, timing, energy levels, and trajectory can help to link the rays to possible events in space that could have produced these showers on earth. There are cosmic ray detectors already in operation yet this model is meant to be compact and visually stimulating to appease buyers yet still operational to maintain detector functionality.

4. Overall Description

4.1. Product Perspective

Build a self-contained portable cosmic ray detector that will later, combined with identical models, form a larger cosmic ray detector capable of tracking trajectory of a given cosmic ray event. The cosmic cube segment will detect cosmic ray showers and differentiate between the particle species entering the device. When interfacing with other cosmic cube segments to form a larger ray detector they will then be able to track trajectory of the cosmic ray event and determine the particle species: gamma rays, electrons, muons, protons and neutrons. The Cosmic cube segment will record the time of the event, synchronizing with a local GPS for increased timing accuracy, and determine whether the event is composed of hadronic or leptonic particles. The segment will be able to provide the user with this raw data, which in turn, the user can develop software or compile the data with those of other users to progress more meaningful insight. The data from the segment can be received wirelessly through the users local Internet network and uploaded onto their computer/laptop/or other Internet enabled devices.

4.2. User Classes and Characteristics

Users of this product might include:

Researchers: Those who want to use the cosmic cube to gather data for studies and projects relating to high-energy cosmic rays. These can be individuals in universities, local high schools, and scientists out in the field.

Backyard Astronomers/General Public: Individuals who don't have funding or work for a major company. These are people who have interest in space maybe as a hobby or career pursuit and want to use the cosmic cube to detect high-energy cosmic ray events in their area.

Special Application Groups: With the added feature of being able to detect gamma rays the portable cosmic cube segment can be used in aiding with the search for nuclear devices and differentiating between materials and locations that have been contaminated my harmful radioactive material.

4.3. Operating Environment

The device is to be operated outdoors to ensure the highest unobstructed detection of particles.

4.4. User Environment

The Cosmic cube is meant to be an open source project where individuals using the device can develop their own means of translating the data provided by the cube such as event time, particle specie, and event trajectory into something more meaningful to them. The user interface will be very simple and rudimentary. Most likely it will consists of a window depicting the raw data and a means to save the data to the local hard drive or external device. Peer-to-peer style sharing, as opposed to central server based, will be utilized to share recorded event data.

5. Requirement Specifications

These define the internal workings of the system that is, the calculations, technical details, sizes data manipulation and processing, and other specific functionality.

5.1.External Interface Requirements

5.1.1. Hardware Interfaces

REQH-001 The sensor transforms high-energy particles into photons and then into an electrical signal.

Test Plan: Use Cobalt-60 source and ensure signal output

5.1.2. Communication Protocols and Interfaces

REQC-001 Data must be transmitted from Cosmic Cube to the user's computer during normal operation.

Test Plan: Check that raw data is being compiled.

5.2.Functional Requirements

5.2.1. Detection Requirements

REQD-001 The system must be able to continuously detect high-energy muons, protons, and electrons from energy levels in the range of 1 GeV.

Test Plan: Check existence of the output of continuous data.

5.2.2. Data Requirements

REQDa-001 The system should be able to output the raw data in a readily available software format found on most personal computers, i.e. a Text file or Microsoft Excel file.

Test Plan: Check existence of the output of raw data in easily readable file format.

5.3.Non-Functional Requirements

5.3.1. Structural Requirements

REQSt-001 The initial requirements of the cube encasing should be no smaller than 15 cm^3 yet no larger than 30 cm^3.

Test Plan: Check size with ruler.

REQSt-002 The cubes should be designed so that they can be reproduced in the future and fit together to create a larger matrix of cubes.

Test Plan: Produce arbitrary boxes that are of same dimension as prototype and ensure that the matrix creates a larger cube.

REQSt-003 The inside of the cube must have no light reaching the sensor.

Test Plan: Shine a bright light at the cube and see if there are any abnormal signals from detector.

REQSt-004 The outermost shell of the system should have removable panels, so different materials can be used for detection of different cosmic particles.

Test Plan: Make sure panels are easily removable.

REQSt-005 The cube should be water resistant.

Test Plan: Check to see if moisture reaches inside of cube when introduced to a light supply of water.

REQSt-006 The system should be strong enough to have some impact resistance in case it is dropped, or knocked off a table.

Test Plan: Test individual components of housing prior to assembly and check for fatigue, loose, or broken components.

5.4. Constraints

The initial budget for the prototype is $750, this is subject change if additional funding is provided. The prototype cube should be designed and at a functional state by April, 2013.

6. References