Halona in 2118

Founded in the year 1742 and formerly called Richmond, Halona is the capital of Virginia, a moniker meaning “Happy Fortune” in Native American. United by nine bridges across a spectacular riverscape, the city is located on the banks of the James River between Virginia's coastal plains and the Piedmont forming a single, diverse, and vibrant city for the 740,000 people living here. Halona’s residents, Halonians, experience moderate temperatures ranging from 48 to 70 degrees Fahrenheit, and an annual precipitation averaging 44 inches.

Halona attained the “Most Livable City” status by the World Health Organization (WHO) and the American Association for Retired Persons (AARP) for incorporating the concept of “Healthy Aging” into its city mandate. It has an average GDP (Gross Domestic Product) growth rate of 8.6% with manufacturing, healthcare, technology and government services forming the basis of the city’s economy. Halonians are highly educated and skilled, transforming Halona into a global leader in sustainable living, advanced transportation, and modernized healthcare. Halona’s demand for 5,000,000 megawatts power is primarily met with clean and renewable energy sources including Nuclear fusion and Solar power.

City Services

Halona has accessible and free health, education, and city services. The healthcare facilities are known for medical innovation in personalized medicine and genomics for preventive care, telemedicine for remote medical advice and Humanoids for in-home care. All buildings feature automatic fire detection, alarm and sprinkler systems that automatically alert fire stations during emergencies. Citizen patrol drones monitor and transmit suspicious activity reducing the risk of crime and abuse in the city. In addition to state-of-the-art schools and universities, educational services include mentoring, entrepreneurial training, and support for seniors to advance in the workforce, and resilience to stay employed longer.

Age-Friendly Problem

In 2017, Richmond’s significance in US history and cultural heritage remained unchallenged, but a growing population strained its infrastructure and increased health disparities. To improve the quality of life, engineers formed a task force with city planners, entrepreneurs, and social workers who worked closely with the Richmond Regional Planning District Commission (RRPDC) and identified the following premises:

- Projected population growth by 131% including senior demographics (age 65 and older) by 47%
- Annually, 7.5 million transit rides were unmet causing loss of access to jobs, medical facilities and necessities
- A study of seniors indicated that 43% felt socially isolated; they want to be part of multi-generational communities for a high sense of security and belonging

As people get older, they experience loss of physical and cognitive abilities. For a healthy lifestyle, barriers to mobility and independent living need to be removed. Lack of sidewalks, lighting, safety, and traffic hinder elderly and disabled from being mobile. The task force perceived an immediate need to solve the mobility problem and proposed two solutions:
1. Compact-Communities
2. HATS (Halona Age-Friendly Transportation System)

Compact-Communities

The Compact-Communities were designed using AARP’s Livability Index, a scoring mechanism that measures quality of life. The solution entailed providing essential services within safe walking distance promoting livability and socialization. Community features include digital directories for navigation, public restrooms, hydroponically grown trees, and ample benches that provide relaxation and improve aesthetics of the surroundings.

Compact-communities have smart homes equipped with non-invasive sensors that are connected to Halona's Artificial Intelligence (AI) systems to track physiological changes like vitals, fall detection and early symptoms of Alzheimer's. Similar technology is extended to wearable biosensors (GPS enabled shoes, biometric clothes) that monitor people 24 hours a day. Voice recognition and video surveillance options provide the support needed for families and caregivers. Communities offer many social programs involving seniors:

- “Adopt-A-Senior”: Pairs students with seniors in a co-housing situation where students get free accommodations in exchange for company and service assistance to the seniors.
- “Healthy Happy Hours”: Seniors to eat healthy, socialize, and share Halona’s history with younger generations.
- “Help Grow the Environment”: Encourages youth and seniors to be “green-nature” responsible.
Figure 1: Compact-Community Blueprint

- Townhouse
- Multi-Sport Arena
- Intra-community roads
- Offices
- Apartments
- Education
- Community Center
- Condominiums
- House
- Townhouse
- Parks
- Roads for HATS vehicles
- Intra-community roads
**HATS**

*HATS*, is a reliable multi-modal transportation system, engineered to ensure that all modes of transit are safe, affordable and accessible to all residents, including seniors. The system comprises of:

- Pedestrian-friendly roads
- Mass transit that includes:
  - PassOver Trams, a quick stop and go service that moves on elevated tracks
  - AutoBuses, autonomous electric buses connecting *compact-communities*
- Underground Delivery System (UDS), an automated tunnel system using Radio Frequency Identification (RFID) to manage freight
- Futuristic Garudas for personal transit
Figure 3

GARUDA MODULES

HATS Accessible Features

LiDAR  Solar Roads  Multi-Language Touchscreen Trip Planner
GPS  Super Computer  Wheels with Speed and Terrain Sensors
Foldable Seat  Wheel Chair  Wireless Charging
First-Aid Robotic Arm  Power Unit  Wheel Chair Ramp
HD Camera  Bladeless Propeller  Twist and Turn Lock
Sensors:  Ultra-Haptics  Fall-Detection
Garuda, a symbol of speed with quality engineering prowess, is a quad-passenger capsule that attaches to a ground or air module. While the ground module is land based, air modules fly within the communities at a relatively low altitude over short distances. At designated transfer pads, passenger capsule switches from ground to air module or vice versa.

Garudas are engineered with:

- Electric drivetrains eliminating mechanical transmissions
- Acoustically designed bladeless fans for enhanced flight control
- LiDAR (Light Detection and Ranging): 3D point cloud sensors for obstruction detection and autonomous navigation
- Electromagnetic monopole magnets to repel Garudas for collision avoidance
- Rechargeable power units, charged by solar roads and docking stations

**Trade-offs, Risks and Benefits**

A major trade-off with the Compact-Communities was it increased building density raising the risk of widespread impact from natural disasters. This risk is mitigated by making all buildings self-sustainable. For example, more than 50% of storm water gets captured on top of buildings, filtered and used to water the terrace gardens, and for drinking water. The excess is pumped into tanks which are used to fill water hydrants or converted into hydroelectric energy.

Autonomous flying capability of Garudas has an inherent risk of crashes and system failure, which were mitigated using advanced sensors and collision avoidance technologies. Garudas are expensive to develop and operate but autonomous features eliminated manual driving costs. Increased regulation made flying safer, while flying safety awareness increased mass adoption of the Garudas. Halona’s engineering solutions positively impacted citizens with following benefits.
## Table 1: Goals and Impacts/Benefits

<table>
<thead>
<tr>
<th>Goals</th>
<th>Health/Social</th>
<th>Economic/Environmental</th>
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<tbody>
<tr>
<td><strong>1</strong></td>
<td>● Pedestrian-friendly roads promoted walkability and reduced obesity, diabetes and cardiovascular diseases&lt;br&gt;● Reduced average commute time by 90%</td>
<td>● Provided efficient last-mile transportation&lt;br&gt;● Increased use of public transportation by 50%</td>
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<td><strong>2</strong></td>
<td>● Reduced accidents&lt;br&gt;● Motor devoid communities freed up nearly 60% of streets&lt;br&gt;● Garudas enhanced convenience with 24-hour on-demand service</td>
<td>● Reduced property damage, and traffic congestion related expenses&lt;br&gt;● Produced zero carbon footprint</td>
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<td><strong>3</strong></td>
<td>● Increased preventive healthcare accessibility&lt;br&gt;● Increased trust with public services</td>
<td>● Reduced healthcare costs with timely medical checkups</td>
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<td><strong>4</strong></td>
<td>● Increased monitoring for vulnerable elderly</td>
<td>● Reduced senior care costs with assistive technologies&lt;br&gt;● Less energy consumption</td>
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<td><strong>5</strong></td>
<td>● Social-Clustering provided bounce back during crisis</td>
<td>● New businesses contributed to economic growth&lt;br&gt;● Enabled eco-friendly storm water management and sustainable food production</td>
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<td><strong>6</strong></td>
<td>● Shorter intra-community distances improved social interaction and mental health</td>
<td>● Increased volunteer opportunities for environmental protection</td>
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Many engineers played a key role in designing and implementing technological and architectural advances that transformed Halona. Civil engineers worked collaboratively with aviation, computer, electrical and electronics engineers to build supercomputers, HATS applications, Garuda and secure communication networks. Human factors engineers worked on the design and use of medical devices, while robotic engineers created people-friendly Humanoids.

Solar and Civil engineers designed futuristic solar roads using recycled plastic and white resin topped with anti-glare durable glass. Solar cells implanted beneath the glass act as a solar power generator producing 7.6 kilowatt hours of energy each day per 12x12 square-foot road. This energy is used to fuel embedded heating elements that defrost the roads with excess used to power neighboring houses and businesses. White roads keep the roads cooler by decreasing the heat island effect by 5 to 10 degrees and also enhance visibility at night.

Halona has a unique and innovative model for inclusion, independent living, and caring for seniors achieved by smart and integrated communities. Additionally, cutting edge transportation system eliminated the mobility problem by providing people of all ages and abilities proximity to services, making Halona a destination for a meaningful life over the century.

Word Count: 1413
Words in Figures: 84
Title = -3
Total Word Count: 1494
Works Cited


